REMARKABLE
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CHAPTER I.

THE QUEEN—THE DRONES—THE WORKERS.

WHO does not know the honey bee? Far and wide is its range; and it was as familiar and interesting to those in ancient as it is in modern times.

Wild bees are frequent in Palestine. Israel is said to have sucked honey from the rock; for there it was found, as well as in hollow trunks or branches of trees. In the east, the bees are all in a wild state; many of the trees literally flow with honey. Large combs full of it may be seen hanging on the branches; hence it is cheap and plentiful, and is much used by some people to preserve the flesh of animals they catch in the chase.

To bees, the philosophers of all ages have given much attention. We read of Aristomachus, of Soli, in Cilicia, who studied them solely for fifty-eight years; and of Philiscus, the Thracian, who spent his days in forests, observing these wonderful little creatures. Reaumur, Hunter, and Huber are among the most eminent in later times who have trod in the steps of these lovers of bees.

A hive of bees contains, on the average, besides the young brood, a female, or queen, 2000 males or drones, and 20,000 workers. The body of the monarch of the hive already portrayed is considerably longer than that of the rest. The prevailing colour in all three is the same, black or black-brown; but that of the female is brighter and purer, and generally of a darker shade.

Drone.

Worker

The drone has a short, thick, and clumsy body; and its head and trunk are covered with dense hairs. The body of the workers is oblong; of these there are two kinds, wax-makers and nurse-bees, whose movements will hereafter be described. Reaumur was curious as to the weight of bees; he found that 336 weighed an ounce, and 5376 a pound. According to Hunter, a pint vessel contains 2160 workers.

A most extraordinary fact in the history of bees is,

that if they are deprived of their queen, and are supplied with comb containing young worker-brood only, they will choose one or more to be reared as queens. Left in their cells, the caterpillars would have become workers; but a royal cell being built for their habitation, and being fed with a very nutritious food, called royal bee-bread, they come forth from the chrysalis state entirely different in form, power, and instincts. Here is a change—arranged and directed by the all-wise God—which is truly wonderful, and is probably without a parallel.

Royal Cell.

The chief office of the queen appears to be the laying of long, slightly curved eggs. of a bluish colour; and this almost always occupies her. A single one only is deposited in each cell. She is slow and majestic in her movements, and accompanied by a guard of twelve workers. This attendance is taken in turn, and never neglected; wherever she goes, her guards clear her path, always turning their faces towards her with the greatest courtesy. When she rests from her labours, they approach her with humility, lick her face, mouth, and eyes, and fondle her with their horns.

The queen lays only workers' eggs for eleven months; after that, those which produce drones. As soon as this change has taken place, the workers begin to make royal cells, in which the queen, without ceasing to lay drones' eggs, deposits here and there about once in three days, an egg intended to produce a queen.

The workers' eggs hatch in a few days, and become little white caterpillars, which immediately open their mouths to be fed: on these the workers wait very attentively. At the end of six days, they roof in the cell of each caterpillar, which then spins a cocoon, and becomes a chrysalis; and on the twenty-first day it comes forth a perfect bee. The queens emerge on the sixteenth day, and the drones on the twenty-fifth.

Caterpillar of the Bee, with its cocoon of silk, which, when expanded, fills the cell, and renders it smooth and soft.

The swarming season begins in the spring. No migration will, indeed, ever take place while the weather is cold; nor while the hive is not well stocked with eggs of every kind. The queen-bee, at length having laid a great number of eggs, has a more slender shape, and is fitted for flight. Her dislike to the royal brood, as if foreseeing that they would soon become her rivals, and her vain attempts to destroy

them, from their being defended by the bees, greatly agitate her. Now the workers become restless; they hurry impatiently to and fro, and the heat of the hive is much increased. A general buzz may soon be heard; it recurs at intervals for some days, during which the bees prepare for their departure. The workers collect a greater quantity of provisions than usual; and scouts are sent forth to look for a proper habitation.

Perhaps the reader has been amused by the reclaiming of a swarm of bees. Sometimes a boy is set to watch, and directly he announces their flight, a ringing is commenced, in country places, on a pan or fire-shovel, "to charm them down," as the villagers say. At length, the queen-bee alights at the end of a bough, and her subjects clustering about her, form a hanging cone of living brown. Some skilful person now spreads a cloth on a table, if one is near, and holding an empty hive inverted under the swarm, shakes them suddenly into it, and places it, with the bees, on the cloth. Thus they are conveyed to the place they are to occupy, and where they speedily make themselves at home.

When a young queen comes forth under ordinary circumstances, the old one often leaves the hive, heading the first swarm for the season. Flying to some neighbouring resting-place, it is observed by the owner,

is captured, placed under a new hive, and a new colony is immediately commenced.

As the summer advances, many queens are hatched; but the workers do not allow them liberty at once, as severe battles would take place between them and the reigning queen, in which one would be killed. The workers, therefore, make a small hole in the ceiling of the royal cell, through which the captive queen thrusts her tongue, and receives food from the workers. Thus confined, she utters a low and complaining note.

If a newly-formed or reigning queen finds such a captive, she tries eagerly to tear open the cell, and destroy her rival. To prevent this, the workers often interpose, pulling her away by the legs and wings. She submits for a short time, when, uttering a peculiar cry, called her voice of sovereignty, she commands instant obedience, and is at once freed from their assaults.

When several queens appear, the bees seem to excite them to fight, and the conqueror is chosen as their queen. But in the swarming time, they appear aware that several queens are required to thin the hive. When it has cast off several swarms, and no more remain than are necessary to preserve the city, the bees no longer show any anxiety about the rest of the royal brood, but allow the royal cells to be torn open

by the first-born queen, and either drag out the young themselves, or permit them to be killed.

That bees can communicate with one another is beyond dispute. When a queen has been taken away, the business of the hive goes on well for about an hour; but afterwards some few workers appear agitated, give up their toils, forsake the young, and roam about in great alarm. As one bee meets another in the hive, they mutually cross their horns, or antennæ, and the one which seems first to have learned the sad news tells the other by gently tapping it with these slender but wondrous parts. The latter, in its turn, becomes agitated, runs over the cells, and, acting in the same way, diffuses the tidings: thus, at length, the whole hive is in confusion; it continues so for four or five hours, after which the bees become calm, and begin to repair their loss.

A poet has said—

> Nature to all, without profusion kind,
> To proper organs proper powers assign'd,
> All in exact proportion to the state;
> Nothing to add, and nothing to abate.

Another, who took revelation for his guide, says—

> Nature is but a name for an effect,
> Whose cause is God:

and in all his works he should receive the honour that is due to his name.

When infidels have been urged to receive the Scriptures, they have often said that God was too great to attend to creatures so insignificant as ourselves. But have we not an answer to their cavil, in the fact just mentioned—the fitness of the organs of an inferior creature for its circumstances? Who that looks attentively at the bee will find anything wanting, anything superfluous? It is plain that God has cared for the bee; and from this it may be inferred that he cares for us. Even the little tenants of the hive furnish an argument which no sceptic can gainsay.

Man, coming forth in innocence from the hand of God, was fully provided for; and now he is fallen, is he left to perish? No; a Saviour is exhibited, able and willing to save to the uttermost. As no sinner ought to presume, so no sinner need despair. Let faith be exercised in Christ, and no good thing shall be withheld, for time or eternity. Well may the believer look upward, and exclaim—

> Thou my hope,
> My joy, my inspiration, and my crown,
> My light in darkness, and my life in death;
> Eternity's too short to speak thy praise,
> Or utter thy profound of love to man—
> To man, of men the meanest, e'en to me!
> My sacrifice, my God, what things are these!

CHAPTER II.

RAMBLES OF THE BEE—HONEY—BEE-BREAD—PROPOLIS.

THE bee, in its excursions, has many things to do. It has to obtain, for instance, the pure fluid, called the nectar of flowers. This affords abundant support for insects less provident, who, rioting in sweets during a summer, scarcely outlive the fall of the blossom; but it is the chief store of the bee. The reader has, perhaps, often sucked it from the long tube of the honeysuckle. But the bee can do this far better. Its tongue is not a little remarkable. If we look at one of these insects, we may easily observe it folded closely down from the mouth towards the throat, where it ends in a point. More narrowly examined, it will be found composed of five pieces. Now, the tongue is not a tube through which the honey may pass, nor a pump to draw it up; but a real tongue to lap or lick the honey, and pass it down on its upper surface, as we do, to the mouth. It is unfolded by the bee with great rapidity; it can be projected forward either curved or straight; and it can be darted at pleasure into every part of a flower

where honey appears. Here, then, we see, as in numberless instances, the wisdom of God, who always beautifully adapts the instrument to its end. Alighting on a flower, the hum produced by the motion of the wings ceases, and instantly the bee unfolds its tongue, which before was rolled up under its head, and lay in a very small compass lest it should receive injury. Now the bee extends it to its full length; then contracts it: nor does it fail to lap the upper and under surface of the petals, so that they may be deprived of all their nectar. And all the while it keeps itself in a vibratory motion. The nectar thus obtained goes into the honey-bag of the bee, where it becomes pure honey.

The bee, however, does not take honey from every flower. In the meadows, these insects may be seen settling on some, but others are untouched; perhaps because of some injurious quality. The oleander, yielding poisonous honey, fatal to thousands of flies, is carefully avoided; and the white and conspicuous nectaries of the crown imperial are passed by unnoticed. But see how they revel when the dog-rose is in blossom, and the balsamic lilacs appear, and the lime is covered with numberless flowers! It is, however, from aromatic plants, such as borage, sage, and lemon-thyme, that they collect the finest flavoured and most delicate honey.

Herbert quaintly says—

> Bees work for man; and yet they never bruise
> Their master's flower, but leave it, having done,
> As fair as ever, and as fit for use;
> So both the flower doth stay, and honey run.

Here, then, the bees may teach many a lesson to those who do not use the things of others with the same care as their own. Articles which are borrowed are often injured by those to whom they are lent. It ought to be otherwise; that which is borrowed from another should be kept with special care, and promptly returned. To forget this, is to requite kindness with ingratitude, to return evil for good. So does not the bee.

The bee, laden with honey, returns to the hive, enters a cell, pierces a hole in the crust on the surface of the sweet fluid already therein, disgorges the honey in large drops from its mouth, forms the crust anew, and closes up the hole. Such is the course of every bee that contributes to the general store. A cell will hold the contents of many honey-bags. Some cells are filled with honey for daily use, and some with what is stored up against a bad season or bad weather. These are covered with a waxen lid.

Bee-bread is also to be procured, which is to serve as food both to the old and young. It is obtained

from the little bags or cases, called anthers, raised on a slender filament or thread in the midst of the flower, and filled with a species of dust or powder. And to secure this treasure, the bee is as well prepared as it is to obtain the nectar. Its body is covered with feathered hairs, and these are the means it employs. Sometimes a bee will appear white, orange, or yellow; but this is entirely owing to the differently coloured dust of various flowers. When the body is thus covered far more thickly than the miller with flour, the bee wipes off the dust with the brushes of its legs, to collect every particle of it, then to knead it, and form it into two little masses.

Hind leg of the Bee, showing the cavity in which the propolis is collected.

Here appears another admirable contrivance. In the middle of the hind pair of the bee's legs there is a sort of basket, the bottom of which is formed of a horn-like, smooth, and shining substance, and surrounded by strong and thickly-set hairs. One mass, when carefully prepared, is therefore placed in each of these receptacles, and thus it is conveyed as safely to the

hive, as the eggs purchased at the market and put in the basket are carried home.

Curiously enough, bees appear to continue to collect pollen from the same kind of flowers with which they first begin; and hence some enter the hive with red pellets, others with yellow ones, others with green ones, and some with pellets of a whitish hue. Most diligent are they in this service. In April and May, they collect pollen from morning to evening; but in the warm months they gather it from the time of first leaving the hive, sometimes as early as four in the morning, to about ten o'clock A.M. All that enter the hive about that time may be seen with pellets in their baskets; during the rest of the day it is brought in more rarely, unless the swarm is recently established.

The bee laden with pollen, on its return, sometimes stops at the entrance of the hive, and very leisurely detaches its load by piecemeal, and devours one or both the pellets on its legs. At others, the bee enters the hive, and walks upon the combs; always, whether standing or walking, beating with its wings. The noise thus made seems to be a call for help: three or four bees advance, place themselves around the newly arrived, and begin to lighten it of its load, each taking and devouring a small piece of the produce. If others

do not come to their aid, they do this three or four times, till the whole is disposed of. When more pollen is collected than is wanted at once, it is stored up in some of the empty cells. The laden bee puts its two hind legs into the cell, and with the middle pair pushes off the pellets. When this is done, this one, or if too much fatigued another, enters the cell with its head first, and remains there some time. Its employment is to dilute the pellets, knead them, and pack them close. A large portion of the cells of some combs is filled with this bee-bread. Everywhere it is ready for use.

Another material required by bees is propolis. This substance is soft, red, and aromatic; it will pull out in a thread, and give a gold colour to white polished metals. Huber traced its origin by planting some cuttings of a species of poplar, when the leaf-buds were swelling, besmeared and filled with a viscid or gluey juice. Placing the pot in which they were in the way of the bees that went from his hives. almost immediately one alighted on a twig, soon opened a bud with its jaws, and drew from it a thread of the gluey matter it contained. With one of its second pair of legs, the bee took it from the mouth, and placed it in the basket used for propolis as well as pollen: thus it proceeded, till each basket had its load. Various

trees appear to yield this substance, which is used in finishing the combs; in stopping every chink through which cold, or wet, or any enemy might enter; in covering the sticks which support the combs; and frequently it is spread over a considerable part of the interior of the hive.

Acquainted with the purpose of its movements, well might a poet say—

Thou cheerful bee! come, freely come,
And travel round my woodbine bower;
Delight me with thy wandering hum,
And rouse me from my musing hour.
Oh try no more yon tedious fields;
Come, taste the sweets my garden yields:
The treasure of each blooming mine,
The bud, the blossom—all are thine!

And careless of the noon-tide heat,
I'll follow as thy ramble guides,
To watch thee pause to chafe thy feet,
And sweep them o'er thy downy sides:
Now in a flower-bell nestling lie,
And all thy busiest ardour ply;
Then o'er the stem, though fair it grow,
With touch rejected, glance and go.

O Nature kind! O labourer wise,
That roam'st along the summer ray,
Glean'st every bliss thy life supplies,
And meet'st prepared thy wintry day

EVILS OF IDLENESS.

> Go, envied, go—with crowded gates
> The hive thy rich return awaits:
> Bear home thy store in triumph gay,
> And shame each idler on thy way!

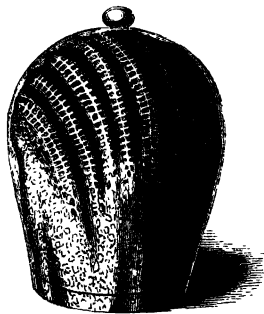
No one of us was intended to pass idly our days. Even in innocence, man was put into the garden of Eden, "to dress it, and to keep it." Six days' employment was marked out, before sin sowed the seeds of the thorn and thistle. Labour, indeed, was not toilsome; it has only been so since a curse rested on the soil for man's transgression; but labour was always the proper business of our race. Idleness is at variance with our best interests.

> Absence of occupation is not rest;
> A mind quite vacant is a mind distrest.

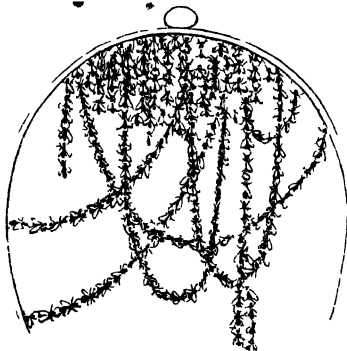
The mind must be engaged, in order to be peaceful and joyous. And there is much to be done; much for our connexions, for the church of Christ, for the world at large; while it behoves us to attend to the charge—"Work out your own salvation with fear and trembling; for it is God which worketh in you both to will and to do of his good pleasure," Phil. ii. 12, 13.

CHAPTER III.

WAX—THE HONEYCOMB—INSTINCT OF THE BEE.

WAX is secreted from small sacks or pockets, situated between the segments of the bee's body, on the under side, in a manner still unknown. It is formed either from honey or sugar. Of this substance the honey-comb is made. It is a flattish cake, composed of a great many cells, regularly applied to each others' sides, and arranged in two layers, placed end to end. A bee-hive exhibits several of these combs fixed vertically to its upper part and sides, at a small distance from each other, so that the cells open in opposite directions. The combs are about half an inch apart: thus two bees, busied on the opposite cells, may

Arrangement of the Combs, as seen in a glass hive.

freely pass each other. Here and there, too, the combs are pierced with holes, which allow direct communication to be made from one to the other, and save the bees' going round. The wax of commerce is produced by melting down these combs.

The process of building the comb calls for our high admiration. It shall now be simply and briefly described After taking a due portion of honey or sugar,

Festoons of Bees secreting wax.

the wax-makers suspend themselves to each other. The claws of the fore legs of the lowermost being fixed to those of the hind pair of the uppermost, they form themselves into a cluster, the outer layer looking like

a kind of curtain. The cluster consists of a series of festoons, which cross each other in all directions.

The wax-makers remain motionless for about twenty-four hours, during which the wax is formed, and thin scales of it may generally be observed under their abdomen. A single bee now comes from one of the central festoons of the cluster, separates itself from the rest, and, with its head, drives away the bees at the beginning of the row, in the middle of the arch, turning round to form a space of an inch or more in diameter, in which it may move freely, and then fixes itself in this space. Here we observe the founder of the comb.

Worker Bee laying the foundation of a Comb on the top of a glass hive.

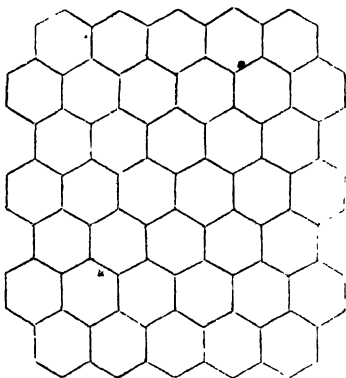
Provided with pincers at the joint of the third pair of legs, it seizes with them a scale of wax, and brings it forward to its mouth, by which it is broken, and, by means of a frothy liquid from the tongue, comes forth in the form of a very narrow riband. Sometimes the tongue appears, during the process, like a trowel, and at others like a pencil. Again the wax is pushed into the jaws to be worked up anew.

Having thus fully prepared some particles of wax, the founder applies them to the vault of the hive, duly

arranging them with the point of its jaws; and when one scale is used, a second is taken, and employed in the same manner. At length, its work is done, and the bee is lost amongst its companions. Another succeeds, and resumes the employment; then a third; all follow the same course. Should any little mass be used improperly, another coming removes it to the proper place. Thus a simple partition is formed.

The nurse-bees must now carry on the work. One of them places itself horizontally on the vault of the hive, and moulds, on one side of the partition, a cavity to be the base of a cell. Others succeed, deepening the cavity, heightening its sides by heaping up the wax, and giving them a more upright form. At the back, and on each side of the first cell, two others are formed; thus the foundations of two cells are laid, and thus, by degrees, the whole is completed.

The shape of the cells is worthy attention; they are all hexagons; that is, they have six sides, as in the following figure. The form of these cells secures a saving both of space and material. Were they squares or triangles, they would fit as closely together as hexagons, but then there would be waste at the corners. Not only is loss now guarded against, but the figure adopted is more suitable to the body of the bee, while it partakes of the strength of the arch.

Reflecting men have often used the suggestions offered by the inferior creatures of God; and here we are reminded of an instance of their doing so. It may be easily supposed that it is very important to make the most of the comparatively little room which even a large vessel affords for its various stores. Ship biscuits, for example, required for a large number of persons, during a long voyage, occupy a considerable space. Formerly there was a great loss of room in their package, from their being made round; but this has of late been obviated by their being made six-sided—the very form of the bee's cell—and so no space is lost.

Other remarkable circumstances remain to be noticed. The cake of wax called a comb is pierced with cells on both sides, and fixed vertically to the upper part of the hive. All the combs are parallel to each other,

and vary from one to two inches in thickness. Cells are made on both sides of each comb: there is, therefore, a partition between them, and their beautiful arrangement will appear from the engraving on the opposite page. In works of human ingenuity, when one evil is remedied, another often arises; but by this arrangement there is no loss, while additional strength and firmness are gained.

If we examine the floor of these cells, we shall find they are not flat, but sloping, being formed by three inclined planes. Most singular is it, too, that there is one angle at which they should meet to combine the greatest strength with the least cost of material; and that bees always form their floors at this very angle. Thus they are led to pursue the course which men, as the result of much calculation, prove to be the best. How marvellous is it that an insect which many consider insignificant should be endowed by a bountiful Provider for its wants with such an instinct! With unfailing regularity, and in the most simple and perfect manner, it secures every advantage.

The form of the base of the cells on one side naturally produces the same arrangement on the other, which could not have been the case if any other form had been adopted, so as also to fulfil other required purposes.

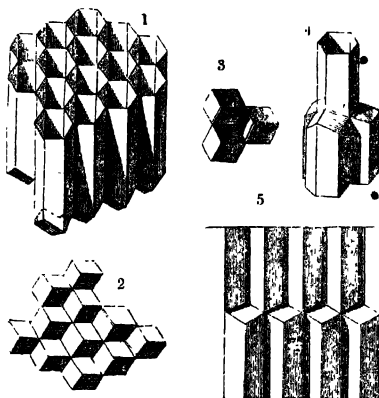



Fig. 1. Cluster of cells from one side of the comb. 2. Plan of the bottom of the cells. 3. Plan of the tops of three cells of one range, to show that by a combination of one plane from each, the bottom of a single opposite cell is formed. 4. Four cells, three on one side, and one on the opposite side, showing the manner in which they join. 5. Sectional plan of two tiers of cells.

Were a jar of honey kept at the common temperature of a hive in warm weather, it would ferment and spoil: why, then, does the honey of the hive continue good? Simply from its being distributed in a number of cells, instead of being together in a mass. There is no larger quantity together than one cell can contain; and each one, when full, is carefully closed from the air by a lid of

wax. The quantity is, therefore, too small for a change which would occur to a mass at the same temperature.

The first range of cells, by which the comb is fastened to the top of the hive, differs from the rest. Here alone they have five sides—the fifth being the broadest, and fixed to the top, so that the comb may be fastened much more securely. So it continues for some time; but, at length, the bees gnaw away the sides of these cells, and, having mixed the wax with propolis, form a cement, with which they build thick and massy walls, and heavy shapeless pillars, to be placed between the comb and the top of the hive, that thus they may be fixed firmly together. Even beyond this their sagacity goes: they neither touch the bottoms of the cells, nor remove both of their sides at once; but they work first on one side, and then on the other, replacing the demolished cells as they proceed, with their strong cement. And why this care? The cells first formed serve well for a time; but as the store of honey increases to the weight of several pounds, they are too frail: hence the use of a stronger material, and the forming of more solid supports.

It appears that bees can alter even the form of their cells, when required by circumstances, and that in a manner truly remarkable. As the bees were making a

comb, Huber placed in front of it a slip of glass, and immediately they seemed aware of the difficulty of fastening it to so slippery a surface. Instead, however, of continuing the comb in a straight line, they so bent it as to extend beyond the slip of glass, and fixed it at length to a part of the wood-work of the hive not covered by the glass. Here a task was accomplished of no little difficulty. They made, too, the cells on the convex side of the bent part of the comb much larger, and those on the concave side much smaller than usual. Nor was this all; for as the bottoms of the small and large cells were as usual common to both, the small ones were considerably wider at the bottom than at the top, and it was the reverse in the large ones.

That bees clearly distinguish between the dwellers in the cells, has been proved by Huber. The large cells of drones have always a convex lid, while the smaller cells of workers have one nearly flat. Huber placed some grubs of workers in the cells of drones, and the change was detected, for the bees gave them a nearly flat covering.

The cells for the drones are considerably larger, and more substantial, than those for the workers; they are formed after the cells of the latter, and are usually nearer the bottom of the comb. The royal cells for

the queens are built last of all; of these there are usually three or four, and sometimes ten or twelve, in a hive, attached commonly to the central part, but often to the edge of the comb. They taper gradually downwards, and have the exterior full of holes: the mouth, which is always at the bottom of the cell, remains open until the caterpillar is ready for its change; it is then closed like the rest. When a queen has come forth, the cell in which she was reared is destroyed, and its place supplied by a row of common cells.

Is there not, then, in these circumstances, a wonderful display of instinct? Were a human artist required to form a similar fabric, he would use the most perfect instruments of various kinds, and glasses to aid his vision; but without any of these the bee labours. The artist would secure, also, a strong light; but the bee works in the dark. Some persons suppose that a glass hive will reveal the movements of its inmates; but in this they err. Bees are averse to light, and quickly close up every chink by which it can enter to disturb them, either by a plaster they form, or by clustering together. Great ingenuity has, therefore, been employed in watching their operations.

When the caterpillars are about to undergo their change, the bees close their cells with a waxen lid;

but these, of course, should be long enough for the movements of their inhabitants. A swarm was placed, on one occasion, in a very flat glass hive, and the bees formed one of the combs parallel to one of the sides, where it was so straight that the cells could not have their usual-depth. The queen, however, laid eggs in them, the workers daily fed their inmates, and the cells were closed at the usual time. A few days afterwards, holes were observed in the lids, out of which the little dwellers partly came, the cells being too short for their motions. The question therefore arose, What will now be done? Will the bees pull the grubs out of the cells as they commonly do when great disorders arise in the combs? But sufficient credit was not given to instinct. The bees saw that the cells were not deep enough, but they allowed the grubs to remain, and gave fresh lids to the cells, more convex than usual, so that they might be deep enough. No more holes were made from that time in the lids.

Huber once found that great ravages had been committed among his own hives, and that his neighbours suffered a similar loss. The offender proved to be that large insect the death's-head moth, so called from its having on its thorax a figure something like that of a human skull. Some surprise was, and still is, felt that so defenceless a creature should dare to enter and

make such spoil. Huber thought that its sound might produce effects on the bees similar to that of the queen, and that they were thus disarmed.

He now determined to make a grating which should admit the bee, but not the moth; and as soon as this was done, the spoil ceased. Strange also to tell, the bees of other hives not so defended formed a similar protection: nor were they all alike, but variously constructed in different hives. "Here," he says, "was a single wall, whose opening arcades were disposed in its higher parts; there were several bulwarks behind each other, like the bastions of our citadels; gateways, masked by walls in front, opened on the face of the second row, while they did not correspond with the apertures of the first. Sometimes a series of intersecting arcades permitted free egress to the bees, but refused admission to their foes. These fortifications were massy, and their substance firm and compact, being composed of propolis and wax."

Bees ventilate their hives, a task which only the workers undertake. To perform it, they unite their wings by their hooks into one piece, and then flap them up and down like a fan. They are usually ranged in files, and station themselves chiefly at the bottom of the hive. Some are outside, and always turn their heads towards the entrance; others are

placed within, and turn theirs in the opposite direction. They seldom exceed in number twenty at a time, and they constantly relieve each other.

Our space now requires us to pause. It has probably occurred to the reader, that the difference is marked between the delicacy of honey in the comb and after its separation from it. Speaking of the revelation of the Divine will to man, or the "judgments of the Lord," the psalmist says: "More to be desired are they than gold, yea, than much fine gold: sweeter also than honey and the honeycomb," Psa. xix. 10. In his estimation, therefore, honey in the comb was as much to be preferred to honey when expressed from it, as pure gold is to that only partially separated from the dross: and rightly did he judge; honey from the comb has a peculiar delicacy of flavour, which, after its extraction, is sought for in vain.

Who that looks at the various facts now related will refuse to say—

> All things that are, though they have several ways,
> Yet in their being join with one advice
> To honour God; and so I give thee praise.
> But who hath praise enough? nay, who hath any?
> None can express thy works but he that knows them.

While, then, we praise God for the volume of nature, let us bless him more for his word, which reveals to us

a Redeemer. He is emphatically the "unspeakable gift:" for who can describe his majesty and glory; his condescension in bearing our sins and carrying our sorrows; the greatness of the blessings which he is now ready to bestow on all who trust in his mediation, and the perfect and eternal happiness which they are hereafter to enjoy?

In closing these remarks on one of the most interesting of the insect tribes, allusion may be made to the wrongs, and a hint given for the kind treatment of the bee:—

Sweet labourer! 'mid the summer's golden hour,
  Full oft I trace thy little busy flight;
With pleasure see thee perch from flower to flower,
  On violets, woodbines, roses, lilies bright.

Yet what to thee is summer's golden smile?
  And what to thee the flower-enamell'd plain?
Will gratitude reward thy daily toil?
  No, no; thou workest for reward in vain.

Not long the hive of treasure will be thine,
  Rapacity will force thy little door;
Those treasures with thy life must thou resign,
  A breathless victim on thy fragrant store!

It is pleasing to know that bees need not now be destroyed. Of late years, means have been successfully adopted to secure alike the honey and the honey-maker. Information in reference to the process may be easily found by any reader to whom it is desirable.

THE FLY.

THE MAY FLY

THE FLY.

CHAPTER I.

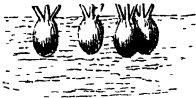
CHANGES OF INSECTS—THE HOUSE-FLY—PROGRESS OF THE FLY TRIBES — THE CRANE-FLY — THE LONG-BEAKED NEMESTRINA —THE BLOW-FLY — THE EPHEMERA — ABUNDANCE OF THESE INSECTS—THE INSECT FLY-CARRIER—THE SPANISH FLY—THE SAW-FLY—THE RESURRECTION.

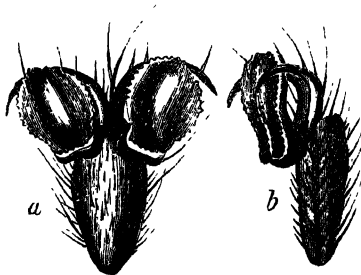
It has been remarked by Sir William Davenant, as to the works of the Almighty:—

> To study God, God's student, man, was made;
> To read him as in Nature's text convey'd,
> Not as in heaven; but as he did descend
> To earth, his easier book: where to suspend
> And save his miracles, each little flower,
> And lesser fly, shows his familiar power!

The facts now to be related will tend to illustrate this statement.

The changes passed through by insects excited the attention of the earliest observers, and present the most curious circumstances in their history.

They exist, generally, in four progressive forms: the egg; the larva, grub, or caterpillar; the pupa, or chrysalis; and the imago, or perfect state,

Eggs of the Domestic Fly.

How remarkable, too, are the movements of those insects which are able to walk along glass, and other polished surfaces, contrary to gravity, and without any waste of exertion! They have, for this purpose, a singular apparatus. The feet are provided with suckers, very beautiful, and wondrously contrived; and which may be easily seen by looking at a fly walking along the opposite side of any clear glass, through a microscope.

Foot of the Blue-bottle Fly magnified.

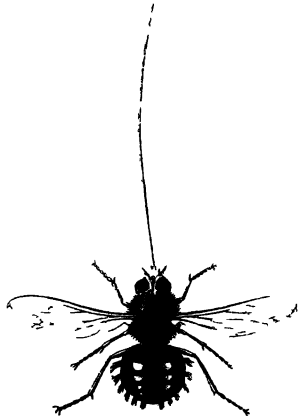
The engraving exhibits the foot of the blue-bottle fly, magnified six thousand four hundred times. It shows (*a*) the under side of the last joint of the toe, with the suckers expanded, as when the insect is walking on a pane of glass. There is also a side view of the same part (*b*.) It will be observed, that there are two suckers, united to the last joint of the toe, immediately under the root of the claw. They spread out from a single root, which is able to move in every direction. When these suckers are applied, they are separated from each other, the surface of each being widely expanded; but, when disengaged, they become nearly closed, and are brought together, so as to be confined within the space between the two claws. The outer edge of each sucker is beautifully toothed like a saw, and the surface, which is concave, is rough with little points. When the fly is walking up a window-pane, on the ceiling, or in any similar circumstances, its motions appear to be regulated by the will of the insect. Each of the six legs is provided with a double sucker. The horse-fly has three suckers on each toe.

The progress of the fly tribes is wonderfully rapid, and usually in a direct line. It has been calculated, that the common house-fly makes with its wings about six hundred strokes every second, by which it is carried

five feet. It is also stated that, if alarmed, the speed of the insect can be increased six or seven fold. A race-horse could only clear ninety feet in the same space of time, which is at the rate of more than a mile in a minute, while the insect, in her swiftest flight, will go more than the third of a mile in the same period. If, then, as Kirby says, we compare the difference of the size of the two animals, as "ten millions of the fly would hardly counterpoise one racer, how wonderful will the velocity of this creature appear! Did the fly equal the race-horse in size, and retain its present powers in the ratio of its magnitude, it would traverse the globe with the rapidity of lightning!"

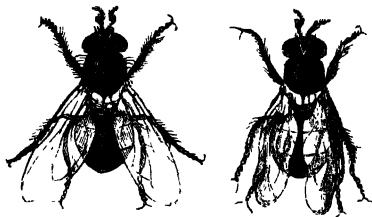
Another insect, the crane-fly, is common in meadows. It is known in England by the name of Harry Long-legs, and of Jenny Nettles in Scotland. One of these insects was observed to make a burrow in the ground for its egg. Choosing a south bank, bare of grass, she stood, with her legs stretched out on each side, and kept turning herself half round backwards and forwards alternately. Thus the egg-placer of the fly made its way into the hard soil, and deposited her eggs in a secure situation. All of them, however, were not committed to the same burrow; for every now and then she shifted her station, but not more than an inch from

where she bored last. While thus engaged, her male companion was observed suspended by one of his legs on a twig, not far from her.

The egg-placer of this insect is beautifully constructed, serving first to bore the earth, and then, as it is tubular, to allow the egg to pass to the spot where the caterpillar, when hatched, will find the food it needs. Instances, however, are abundant, of a nice adaptation of the parts of the creature to its condition. One of these appears in the long-beaked fly, which most probably uses the extraordinary trunk with which it is provided, in collecting the juices which form its food.

The Nemestrina, or Long-beaked Fly.

Well may we pause, and, in admiration of the works of the great Creator, exclaim with the poet—

'Tis sweet to muse upon his skill display'd,
Infinite skill in all that he has made;
To trace, in Nature's most minute design,
The signature and stamp of power Divine!
Contrivance intricate, express'd with ease,
Where unassisted sight no beauty sees;
The shapely limb, the lubricated joint
Within the small dimensions of a point,
Muscle and nerve miraculously spun!
His mighty work, who speaks—and it is done.

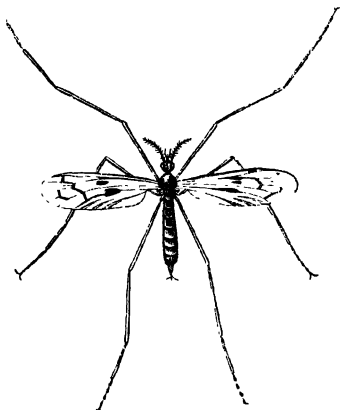
Passing on to other insects, it may be remarked, that the blow-fly, in common with several more, instead of laying eggs like the majority of insects, hatches them

Magnified Blow-flies: one newly hatched.

in its own body, and deposits them, in the state of caterpillars, without feet. This peculiarity appears in consequence of their being appointed to cleanse the surface

of the earth from dead and putrefying animal matter. For this purpose it was necessary that no time should be lost in developing the labourers to undertake the task, and also that their number should be proportioned to the work they have to do. These ends are, therefore, secured by extraordinary means. It has been ascertained, that one of these flies will produce twenty thousand young; and that in a fortnight they attain their full growth, and produce others.

The may-flies, or ephemeræ, so called because their lives, in the perfect state, last only for a day, are exceedingly numerous. It is said, on authority which cannot be disputed, that myriads of millions of these insects come forth at a certain season of the year, from some of the rivers in France. In their early stages they either live in holes in the banks of rivers, or in brooks, below the water, so that it enters into their habitations. These they seldom quit; or they swim about, and walk on the bed of the stream, or conceal themselves under stones, or upon pieces of stick. Some continue in these circumstances one, others two, and others even three years.

Although the different species become perfect at different times of the year, the same species appear regularly at nearly the same period annually. During a certain number of days they fill the air in the

neighbourhood of the rivers. One species, remarkable for the whiteness of its wings, sometimes rises and falls in such quantities on the banks, as to thicken the air,

The May-fly.

and whiten the surface of the ground, reminding us, amidst the verdant and leafy summer, of

The flaky weight of winter's purest snows.

The celebrated naturalist Reaumur, having been apprised by his fisherman, that the flies had appeared, got into his boat about three hours before sunset, and

detached from the banks of the river several masses of earth filled with chrysalises, which he put into a large tub, full of water. After staying in the boat till about eight o'clock, without seeing any remarkable number of the flies, and being threatened with a storm, he gave orders for the tub to be landed, and placed in his garden, at the foot of which ran the river Marne. Before, however, his orders could be obeyed, an astonishing number of ephemeræ came forth. Every piece of earth that was above the surface of the water was covered by them, some beginning to quit the chrysalis, others prepared to fly, and others already on the wing. Everywhere they were to be seen, in a more or less forward state, under the water.

The storm coming on, he was obliged to retire; but when the rain ceased to fall, he returned. The tub had been covered with a cloth, and as soon as it was removed, the number of flies appeared to be much greater, and kept continually increasing. Many flew away, but many more were drowned. Those already changed, or changing, would of themselves have been enough to make the tub seem full; but others, attracted by the light, very much enlarged their number. To prevent their being drowned, Reaumur caused the tub again to be covered with the cloth, and over it he

held the light, which was soon concealed by a layer of these flies, which might have been taken by hundreds from the candlestick.

The history of the insect fly-carrier is very remarkable. The process it undergoes was described, several years ago, by M. des Lozières, as the result of his own observations in the island of St. Domingo. This insect, like the silkworm, is produced from eggs deposited by a butterfly of a whitish or light pearl colour. It is hatched towards the latter end of July; and so rapid is its growth, that in September the caterpillar is changed into a butterfly. It first comes forth arrayed in the most brilliant and variegated colours; it feeds on the leaves of the indigo and cassada plants, and, as it continues its ravages day and night, it is considered by the planters as a great evil.

In the month of August the caterpillar undergoes one of its changes. Putting off the beautiful hues in which it first appeared, it reflects all the shades of one colour—a sea-green, according to the lights in which it is beheld. It is now attacked by a very small fly, and that in such swarms, that it is said there is not one spot on its back or sides that appears uncovered by them. Immediately these insects deposit their eggs on the body of the caterpillar, which appears for a short

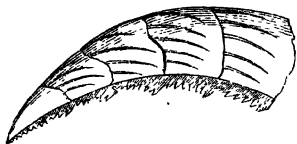
time afterwards in a state of lethargy, and then awakes, to feed with renewed activity.

In about fourteen days after, during which time the caterpillar increases in size, it is to be seen completely covered with a garment of living creatures, of a deep brown colour, the top of the head, however, only being visible. On more minute examination, it is found that each one of these little creatures, raising itself on its hinder part, swings its body to and fro in every direction, and forms for itself an extremely small egg-shaped cocoon, remaining, like the silk-worm, within the ball.

The millions on millions of cocoons thus singularly produced, and that in about the space of two hours, are placed so closely together, that they form a white robe, in which the creature appears elegantly clothed. While this decoration proceeds, the caterpillar appears in a torpid state; but no sooner is the robe completed, than the wearer seeks to free itself, and succeeds in the effort. Its appetite is now gone; it speedily passes to the state of a chrysalis, then becomes a butterfly, and, after producing many hundred eggs, dies. When about eight days have elapsed from the first formation of the small cocoons already described, flies issue from these, leaving the fibrous substance pure, beautifully fine, and

of a dazzling whiteness. This, without any preparation, may, it is said, be carded and spun.

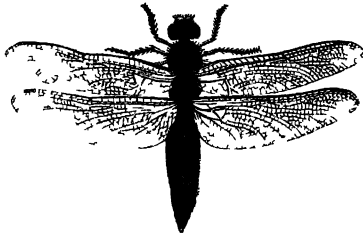
Of the Spanish fly but little is known. A knowledge of its medicinal uses appears to be of comparatively recent date. It is common in France, Italy, and Spain; but the greater proportion comes from the country last mentioned, and hence the name given to the insect. When properly prepared, Spanish flies retain their blistering qualities for a long time.

A most singular egg-placer in the body of a little four-winged creature has obtained for it the name of the saw-fly. In a sheath there is a saw, of a horny substance, with which these insects penetrate the branches and other parst of plants in order to deposit their eggs. The grubs, which often strip rose, gooseberry, raspberry, and red-currant trees of their leaves, and invade the birch, alder, and willow, may be known by having from sixteen to twenty-eight feet, by which they usually hang to the leaf they feed on, while the hinder part of the body is coiled up like a watch-spring. Some of the most common of the

Saw of the Saw-fly.

perfect flies have a flat body, of a yellow or orange colour, while the head and shoulders are black.

In the fine summer mornings, the female of the rose saw-fly may be seen eagerly traversing the branches of a shrub, one after another. Usually resting on the one nearest to the end of the principal stem, she makes an opening with her saw, and when the hole is of the proper size, deposits an egg in the cavity. She then remains quiet for a few moments, draws away the greater part of her egg-placer, and, at the same time, emits a frothy liquid; which rises as far as the outer edges of the notch, and sometimes beyond them. She now proceeds to make another hole, sometimes producing only four in a line, one after another, but generally about twenty. The part of the branch so notched in many places, shows nothing remarkable the first day; it is not till the second that it begins to assume a brown colour. In the end, all the wounds become raised, and more and more round. This growth is owing to the increased size of each egg, which daily grows larger, and forces the skin of the branch upwards. The caterpillar, in coming out of the egg, sucks the leaves of the shrub on which it is nourished.

Who, it may be asked, accustomed to observation, has not been struck by the light and graceful form of the

dragon-flies, their varied and brilliant colours, and the speed with which they pursue their flying prey? And

The Dragon-fly.

yet, perhaps, an inquiry into their previous circumstances, singular as they are, is very rarely made. It is desirable, however, for all to consider the words of the psalmist:

> The works of the Lord are great,
> Sought out of all them that have pleasure therein
> His work is honourable and glorious;
> And his righteousness endureth for ever.
> He hath made his wonderful works to be remembered.

The dragon-flies pass their earlier states beneath the waters. The caterpillars and chrysalises are, in form, somewhat like the perfect insects, and breathe by parti-

CHAPTER II.

THE FIRE-FLY—THE HESSIAN-FLY—THE BREEZE-FLY, OR BOT—THE GAD-FLY—THE GNAT—THE MOSQUITO—THE ZIMB—THE PLAGUE OF FLIES—DIVINE PROTECTION.

EUROPE has some luminous insects, but it cannot vie, in this respect, with the hotter regions of the globe. It is in the regions of the humming-bird, that winged gem, whose lustre seems borrowed from a tropical sun, that we are to seek for the insect lamps of night, "now motionless and dark, eluding search," "and anon starring the sky, like a shower of fire." Most have heard of the fire-fly of St. Domingo and the West India islands. The fire-fly is about an inch in length, and one-third in breadth; it gives out its principal light from two transparent eye-like tubercles, placed upon the chest; but there are also two luminous patches concealed under the horny wing-cases, which are not visible, except when the insect is flying, at which time it appears adorned with four brilliant gems of the most beautiful golden blue lustre; in fact, the whole body is full of light, which shines out between the abdominal segments,

when stretched. We are told that the original natives (a race whose memory even is passing away) were formerly accustomed to employ these living lamps, which

The Fire-fly.

they called Cucuij, instead of candles, in their evening household occupations. In travelling at night, they used to tie one to each great toe, and in fishing and hunting required no other flambeau. Besides this, they were sought for, and encouraged in houses, and especially sleeping-rooms, as extirpators of gnats, which constitute a great part of their food. The fire-fly is common in the inter-tropical regions of the American continent, as

well as the West Indies. In addition to the one just mentioned, several other allied species are also luminous. But of all luminous insects, the lantern-fly of South America is said to be pre-eminent.

It is necessary now to notice some of those flies from which we sustain injury. Many insects, as is well known, invade our fields. Wheat is exposed to their ravages, from the time in which the green blade shoots forth from the earth, to that in which, having been cut down by the sickle of the reaper, it is carefully deposited in the barn. And, in various ways, are we sufferers from such visitants of our plants, which are often as remarkable for their numbers as their voracity.

In America, the Hessian-fly is notorious for its depredations. Nothing intercepts these insects in their destructive career, not even lofty mountains or the broadest rivers. They have been seen to cross the Delaware like a cloud. So great were, at this time, the numbers of this fly, that in wheat harvest the houses swarmed with them, to the great annoyance of the inhabitants. They filled every plate or vessel that was in use, and in a single glass tumbler, exposed to them for a few minutes, five hundred were counted.

Other insects attack animals. Thus the breeze-fly, or, as it is usually called, the bot, assails the horse. In

approaching the animal for the purpose of depositing her egg, she carries her body nearly upright in the air. Suspending herself for a few seconds before the part of the horse she intends to attack, she suddenly darts upon it, and leaves the egg adhering to the hair, by means of a glutinous liquor, with which it is covered. Going then a short distance from the horse, she prepares a second egg; and, after again keeping before the part, deposits it in the same way, and the egg, in like manner, becomes firmly glued. These movements are repeated till sometimes four or five hundred eggs are placed on one horse.

The fly, in so doing, selects the parts most likely to be licked by the horse; but very commonly the eggs are deposited on the shoulder of the animal, which cannot be reached by his mouth. How then can they reach the stomach of the horse, to which it is designed they should go? By a provision well deserving of notice. After four or five days, the eggs remaining on the hair become mature, and the slightest warmth or moisture is then sufficient to call forth from within the caterpillar. If, therefore, the egg is touched by the lips or tongue of the horse, the caterpillar is freed, and readily adhering to the surface of the tongue, is conveyed with the food into the stomach. It is pro-

bable that the greater part of these eggs are thus taken up from the irritations produced in the parts where they are lodged by other flies.

The caterpillars usually hang in thick clusters from the lining of the stomach of the animal, and keep their hold by means of two dark-brown hooks, between which is the mouth of the insect. When matured, the caterpillar quits the stomach of the animal, falls to the ground, and finding a suitable place of retreat, becomes a chrysalis. After remaining in the latter state for a few weeks, the parts of the future insect being hardened by drying, it bursts from its confinement, and delights itself in the air.

Another insect attacks cattle generally. Truly has the poet said of the herdsman—

> Light fly his slumbers—if perchance a flight
> Of angry gad-flies fasten on his herd,
> That startling scatter from the shallow brook,
> In search of lavish stream. Tossing the foam,
> They scorn the keeper's voice, and scour the plain
> Through all the bright serenity of noon.

This foe is a very beautiful insect, and one of the largest of the European species. It inflicts greater pain in depositing its eggs than any other species. Whenever one of the cattle is attacked, the assault is easily known by the extreme terror and agitation of the

whole herd. The unfortunate animal runs bellowing from among them, while, from the severity of the pain, the tail is held with a tremulous motion straight from the body in the direction of the spine, and the head and neck are also stretched out to the utmost. The rest of the cattle, impelled by fear, generally follow to the water, or become dispersed about the field. Such is the dread they have of this fly, that one of them has been seen to meet the herd when almost driven home, and to turn them back, regardless of the stones, sticks, and noise of the drivers, nor could they be stopped till they had reached their usual retreat in the water. When oxen are yoked to the plough, such attacks are dangerous, as the animals are beyond all control, and will often run with the plough directly forwards, through the hedges, or whatever obstructs their way.

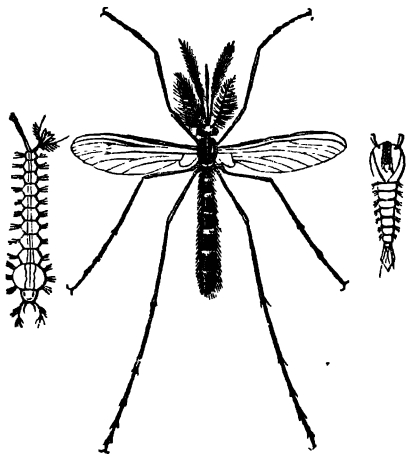
Male and Female Gad-fly, Caterpillar, and Chrysalis.

The foe of the sheep may now be described: it is thought to deposit its eggs on the inner margin of the

nostril. The moment this part of the animal is touched the effect is apparent. The sheep shake their heads, and strike the ground violently with their fore feet; at the same time holding their noses close to the earth, they run away, looking about them on every side, to see if the fly continues its pursuit. They also smell the grass as they go, to know if one is lying in wait. If one is observed, they gallop back, or take some other direction. As, unlike the horses, they cannot take refuge in water, they repair to a rut, or dry dusty road, or to gravel-pits, where they crowd together during the heat of the day, with their noses held close to the ground, which renders it difficult for the fly to get to the nostril.

Of all the insect tormentors, however, none are so loudly and universally complained of as the gnat tribe, to which, in this country, we are sometimes exposed. Yet what are the inconveniences we experience compared with what is endured in other regions! A few examples of this may teach us to be grateful for mercies, which, because they are in the ordinary course of events, are never thought of.

Let us travel northwards. One would think the cold of Lapland would destroy insect life; but it is not so. There the gad-fly, the terror of the rein-deer, obliges the

herdsman to take long and toilsome migrations with his cattle from the interior to the coast, and from the coast

The Gnat, Caterpillar, and Chrysalis.

to the interior, at stated periods. To remain in the woods during summer, would be to insure the total loss of his deer, to him his wealth and dependence. The wild herds migrate instinctively. But the gad-fly is not the only pest in that climate; countless myriads of mosquitoes, whose "numbers are so prodigious as to be

compared to a flight of snow when the flakes fall thickest; or to the dust of the earth," deluge the land. "The natives cannot take a mouthful of food, or lay down to sleep in their cabins, unless they be fumigated almost to suffocation. In the air you cannot draw your breath without having your mouth and nostrils filled with them; and unguents of tar, or nets steeped in fetid birch oil, are scarcely sufficient to protect the case-hardened cuticle of the Laplander from their bite."

In the Crimea, a part of Russia, Dr. Clarke states, that the soldiers are obliged to sleep in sacks, as a defence against gnats; and that, in spite of every precaution, several die in consequence of mortification produced by their bites. The bodies of himself and his companions, notwithstanding the protection of gloves, handkerchiefs, etc., were one entire wound, producing great swelling and fever. "The noise they make in flying cannot be conceived by those who have heard gnats only in England." It is a "most fearful sound."

If we pass from the northern to the tropical regions, we find the pest still raging. Humboldt says, "Between the little harbour of Higuerote and the mouth or the Rio Unare, the wretched inhabitants are accustomed to stretch themselves on the ground, and pass the night buried in the sand, three or four inches deep, leaving

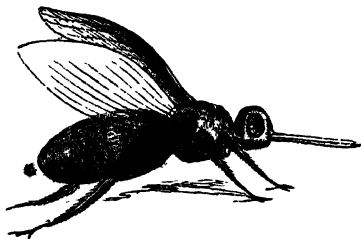
out the head, which they cover with a handkerchief." Here the mosquitoes carry on the warfare by day, the temporañeros (a kind of *culex*) by twilight, and the zancudos (another species of *culex*) by night; so that there is no cessation of their attacks.

Insects, like other conquerors, have given their name to territories; as, for example, Mosquito Bay, in St. Christopher's; Mosquitos, a town in Cuba; and Mosquito Country, in North America. A traveller in Canada thus describes the assaults of some little insects, most probably mosquitoes:—"Your forehead will be streaming with blood before you are sensible of being amongst them. I have sat down to write, and have been obliged to throw away my pen in consequence of their irritating bite, which has obliged me every moment to raise my hand to my eyes, nose, mouth, and ears in constant succession."

It is supposed that the eggs of the mosquito, like those of other gnats, are deposited on the surface of the water, and by means of its moisture and the warmth of the sun, are matured. The food of the caterpillar is unknown: when it has reached its full growth, it spins a little silken sheath; this is attached to the plant which the insect frequents; in it the caterpillar becomes a chrysalis in an upright position, the case being always

open at top. At length, the little creature bursts from its sheath, and the perfect insect emerges through the opening, surrounded by a bubble of air. Slowly it begins to unfold its wings under the water; and when its skin is cast, and its maturity attained, it escapes from its former dwelling, mounts within its bubble to the surface of the water, when the bubble bursts, and the insect appears with new powers in a new element.

A more terrible insect still is the zimb, a native of Abyssinia. Small as it is, the lion and the tiger, and even the largest living creatures, tremble before it. As soon as the buzzing of these insects is heard, the cattle forsake their food, and run wildly about the plain till they die, worn out with hunger, fatigue, and fright. The camel, the elephant, and the rhinoceros, though the last two coat themselves with mud, are attacked by the zimb, and afflicted with many tumors. The inhabitants of the sea-coast are obliged, in the beginning of the rainy season, to remove to the nearest sand, to prevent their stock of cattle from being destroyed. According to Bruce, the inhabitants of all the countries from the mountains of Abyssinia northward, to the confluence of the Nile and Astaboras, are, once a year, obliged to change their abode, and seek protection in the sands of Beja. Nor are there any

means of avoiding this, though there were in the way a hostile band, capable of spoiling them of half their substance.

The Zimb.

It was by a plague of flies that Jehovah laid waste the land of Egypt, and humbled the haughty and presumptuous spirit of Pharaoh: "He sent divers sorts of flies among them, which devoured them," Psa. lxxviii. 45. In connexion with the threat of this evil, there was the remarkable declaration—"I will sever in that day the land of Goshen, in which my people dwell, that no swarms of flies shall be there; to the end thou mayest know that I am the Lord in the midst of the earth. And I will put a division between my people and thy people: to-morrow shall this sign be," Exod. viii. 22, 23. It may be that the Israelites, for their correction,

had, in some small degree, felt the former plagues; at least, the distinction between them and the Egyptians had not been so particularly marked as it would be on this occasion. The land of Goshen was one of pasture, which was not tilled or sown, because it was not overflowed by the Nile. But the land overflowed by the Nile was the black earth of the valley of Egypt, and it was to this that God confined the flies. Thus it must appear, that Jehovah, the God of the whole earth, graciously and miraculously protected the region inhabited by his worshippers, while he executed judgment on his enemies who dwelt at their side, and that by means of flies, which so readily pass from place to place.

A view of the evils to which reference has been made may suggest to the reader others to which there is a constant exposure. Is it asked, How can we find security from them? It may be replied, in the words of our Christian poet Montgomery—

> Call Jehovah thy salvation,
> Rest beneath the Almighty's shade;
> In his secret habitation
> Dwell, nor ever be dismay'd:
> There no tumult can alarm thee;
> Thou shalt dread no hidden snare;
> Guile nor violence can harm thee,
> In eternal safeguard there.

DIVINE PROTECTION.

Only with thine eye, the anguish
  Of the wicked thou shalt see,
When by slow disease they languish,
  When they perish suddenly:
Thee, though winds and waves be swelling,
  God, thine hope, shall bear through all;
Plague shall not come nigh thy dwelling,
  Thee no evil shall befall.

He shall charge his angel legions
  Watch and ward o'er thee to keep,
Though thou walk through hostile regions,
  Though in desert wilds thou sleep:
On the lion, vainly roaring,
  On his young, thy foot shall tread;
And the dragon's den exploring,
  Thou shalt bruise the serpent's head.

Since with pure and firm affection
  Thou on God hast set thy love,
With the wings of his protection
  He will shield thee from above:
Thou shalt call on him in trouble,
  He will hearken, he will save;
Here for grief reward thee double,
  Crown with life beyond the grave.

May it not, then, be added, with the deepest emphasis, Happy are the people that are in such a case; unspeakably happy are the people whose God is the Lord!

THE ANT.

THE ANT'S NEST

THE ANT.

CHAPTER I.

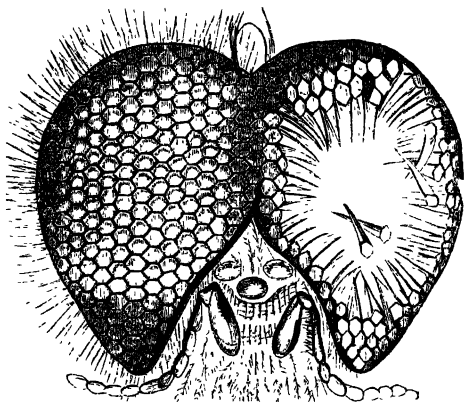
THREE CLASSES OF ANTS—THEIR POWERS, SWARMS, AND LABOURS.

COME, let us look together at creatures which have long been considered very interesting. Ants are of three classes—males, females, and neuters; the latter are also called labourers, or workers, from their doing

Male. Female. Neuter.

all that is necessary to the existence and welfare of the community to which they belong. They collect supplies of food, exploring the country for this purpose, and seizing on all animal substances, whether living or dead, which they can lay hold of and carry to their nest. They construct every part of the dwellings,

attend the hatching of the eggs, feed the caterpillars, and remove them, as occasion may require, to different places favourable to their growth. They also, as aggressors and defenders, fight all battles, and provide for the safety of their weaker companions. Truly their services are various and valuable!

These little creatures have no wings; and they have to bear severe toil in traversing the ground, and in climbing up the steep paths that may lie in their way,

A Compound Eye, greatly magnified.

a, an Eye in its perfect state; *b*, an Eye deprived of the Cornea and some of its Facettes, to show its structure.

while their companions fly freely in the air. The males and females have simple and compound eyes: the latter, when viewed under a microscope, consisting of a great number of hexagonal, or six-sided pieces. As the eyes of insects are not movable, this form is equal to the possession of hundreds of thousands, each piece reflecting distinctly the object before it. The labouring ants are often without the simple eyes: hence it is supposed that these are chiefly adapted to distant objects. Two species have been discovered with no appearance of eyes: one dwelling in the forest of Guiana, and therefore little known; the other met with in France, which hides itself in dark places during the day, and only comes forth at night. These want no eyes, and consequently they are without them.

The sense of smell in ants is acute, guiding them to their food, and enabling them to follow in the path of their companions. If the end of the finger be passed across the line of their march, so as to brush off the odorous particles which the preceding ones have left, those which follow will stop at this place, and proceed irregularly till they have passed over it, when they soon find out the path, and proceed confidently as before. Sometimes, however, this is not the case. A naturalist walking on Hampstead Heath observed a track of

some ants several yards in length, which led to a numerous colony, and was crowded through its whole extent with foragers. He now drew his walkingstick across this track in several places, and all were instantly thrown into confusion, wandering about as if they were blindfold; and though he remained on the spot a considerable time, to notice their movements, they did not succeed in reuniting the parts which had been broken, though most of them reached the nest by a roundabout course.

The strength of these creatures is not a little surprising. Kirby has in his cabinet an insect, to one of the legs of which a small ant, scarcely a thirteenth part of its bulk, is fixed by its jaws. It had probably dared to attack this giant, and refusing to let go its hold was starved to death. Two or three ants have been observed dragging along a young snake, not dead, which was the thickness of a goosequill.

Their perseverance is equally remarkable. The swampy tracts of Paraguay, for instance, are inhabited by a little black ant, its nest resembling conical hillocks of earth, placed very near each other, and about three feet high. When an inundation takes place, these insects are heaped together in a circular mass, about a foot in diameter, and four fingers in depth; and in this manner

they continue to float so long as it lasts. One side of the heap is fastened to some sprig of grass, or piece of wood, and the ants return to their dwelling when the waters are gone. When they wish to pass from one place to another, they may often be seen formed into a bridge of two palms' length, and of the breadth of a finger, having no other support than that of its two ends. The masses remain floating during the flood, which lasts some days.

Hüber tells us that ants communicate with one another like bees, by their antennæ, or horns, and that by them they are enabled to help one another in their wants, labours, and dangers. "We see, then," he adds, "that insects which live in society are in possession of a language; and, in consequence of enjoying a language in common with us, although of an inferior degree, have they not greater importance in our eyes, and do they not embellish the very spectacle of the universe?"

A nest of ants discovered a closet in a nobleman's garden, in which conserves were kept; and this they constantly visited until they were destroyed. Some ants in their rambles must have first found out this treasure of sweets, and told their companions. They always went to the closet by the same track, scarcely varying an inch on either side, though they had to pass through

two rooms; nor could the sweeping and cleaning of the apartments disturb them, or cause them to take a different road.

Hüber describes them as able to recognise one another after a long absence. He took some ants wild from the wood, and placed them in his glass hive; and finding these insects were very numerous, he allowed some to escape, which formed a nest in the garden. Carrying those in the hive into his study, he observed their habits for four months, after which he placed the hive in the garden within fifteen paces of the others. The ants in it immediately recognised their former associates, caressed them with their antennæ, and, taking them up in their jaws, led them to their own abode. Others soon arrived in crowds, and carried off the fugitives in a similar manner, and in a few days all were removed.

May it be said that they can sympathize with one another in suffering? One fact appears to lead to the affirmative. An eminent naturalist, Latreille, cut off the antennæ of an ant; and afterwards he observed another approach, caress it with seeming tenderness, and pour a drop of liquid from its mouth into the wound. That they like to promote each other's pleasure is at least as obvious. Hüber, on one occasion, increased the heat in a part of a nest by means of a torch; when the ants

that happened to be near, after enjoying it for a time, hastened with the news to their companions. So desirous, too, were they that they should enjoy the pleasure, that hundreds might be seen carrying their friends thither.

Ants swarm, but not like bees, who go in numbers to find a new habitation in which they may dwell. Their infant colonies appear to consist of very small parties, all perhaps the offspring of a common parent, who has migrated alone, or with but few companions. The greater part of the females, prepared to deposit their eggs, and alighting in the neighbourhood of the nest, are seized by the labourers, who drag them thither, and keep them prisoners until they are laid. Each female is attended, too, by a retinue of these ants, who treat her with the greatest deference, and are anxious to anticipate her wants. Unlike bees, many females dwell harmoniously in the same nest.

The eggs when first laid are very small, but enlarge before the caterpillar comes forth. It seems they are nourished by those who have the care of them constantly licking them with their tongues. At the end of a fortnight the caterpillar appears in the form of a transparent grub, with a head and wings. The nurses feed it with a fluid they disgorge; and as the caterpillars are very

tender, the ants are constantly employed in conveying them to different parts of the nest, where the temperature is suited to them.

Only let an ant's nest be disturbed, and their vigilance will be seen. Much less occupied in providing for their own safety than for that of the caterpillars, all are in motion, and no danger can stop them in their labours. An observer cruelly cut an ant in two, but the poor creature did not relax; and with the half of the body which bore the head, it carried off ten caterpillars into the interior of the nest before it died.

Other labours are worthy of notice. It is necessary that the caterpillars should be kept very clean; and so the ants constantly pass their tongues and jaws over their bodies, and thus render them perfectly white. After the grubs have reached their full growth, they surround themselves with a silken cocoon, and become pupæ, or chrysalises, which, food excepted, require as much attention as before. They are removed from the bottom of the nest to the surface every morning, and are taken back again every evening. Even the extraction of the ants from the cocoon is the business of the workers. They know that the perfect insect is ready to appear, but too weak to effect its escape; but how they know this we cannot tell. As soon, however, as the period has

arrived, all are in a great bustle. Three or four mount on one cocoon, and begin to open it where the head lies, and apparently with great care. The first effort is by pulling off a few threads to thin that part; several small openings are then made, and very patiently they cut the threads one by one, until, with the utmost gentleness, an opening is formed, which allows the prisoner to escape.

Still the ant has a covering; but this the workers pull off, carefully relieving every member from its case, and when there are wings, nicely opening them. Even now their labours do not end. For several days they follow and watch the young insects everywhere, teaching them to thread the paths and windings of the common dwelling, nourishing them with the greatest care, and also performing the difficult task of stretching the wings of the males and females, which would otherwise remain folded up; and that so carefully as not to injure these frail and delicate members. When, too, the latter take their flight, the workers accompany them to the summit of the highest herbs, showing still the tenderest solicitude, some even endeavouring to retain them, feeding them for the last time, caressing them, and, when at length they rise into the air and disappear, seeming to linger over those whom they have watched so carefully

and will never see again. There is no parallel to this in the whole animal world.

What, it may be asked, becomes of the real parents? And doubtless it might be replied, They are properly employed, when it is so wisely ordered that their place should be fully supplied. The fact is, they are not wanting in affection; but when a colony is founded, they have enough to do to supply it with eggs for future females, males, and workers, which are said to be laid at three different seasons. Here is the proper duty of the mother, and it is faithfully done. Unlike creatures of a higher order, she betrays no trust. What is required of her, at different periods, is performed promptly and well. Occupied now in the manner just described, yet when the nest was first formed she did all that such a mother could do; and it was only when the workers became numerous enough to perform their proper tasks, and relieve her, that she left the young to their charge, and employed herself in increasing the colony.

One fact, in proof of her affection, ought not to be omitted. When a female first issues from the chrysalis, she is adorned with two pair of wings, one pair being larger then her body. But prepared to lay eggs, she twists and contorts her wings, till they finally drop off, and gives herself wholly to the work committed to her.

In concluding this chapter, the words of Solomon should be recalled: "Go to the ant, thou sluggard; consider her ways, and be wise: which having no guide, overseer, or ruler, provideth her meat in the summer, and gathereth her food in the harvest," Prov. vi. 6—8. What a reproof is thus given to the indolence which is so common, and which is most lamentably displayed, in reference to the concerns of the soul!

> The little ants, for one poor grain,
> Labour, and tug, and strive;
> Yet we who have a heaven to obtain,
> How negligent we live!

It ought to be otherwise. To every reader the charge comes, "Work out your own salvation with fear and trembling;" while the declaration is encouraging, "It is God which worketh in you both to will and to do of his good pleasure," Phil. ii. 12, 13. Let each one say, then, "I must work the works of Him that sent me, while it is day: the night cometh, when no man can work," John ix. 4.

CHAPTER II.

VARIOUS DWELLINGS OF ANTS—HABITS OF SOME OF THESE CREATURES—THE WHITE ANTS.

LET us now notice the dwellings of ants. They are formed of earth, hewn out in the trunk of the most solid trees, or simply composed of leaves and stalks of plants; but the size of the habitation is always astonishing when compared with the builders. Our poet Clare has happily described them and their labours:—

> Thou little insect, infinitely small,
> What curious texture marks thy tiny frame!
> How seeming large thy foresight, and withal,
> Thy labouring talents not unworthy fame,
> To raise such monstrous hills along the plain,
> Larger than mountains when compared with thee:
> To drag the crumbs dropp'd by the village swain,
> Huge size to thine, is strange indeed to me!
> But that great instinct which foretells the cold,
> And bids to guard 'gainst winter's wasteful power,
> Endues this mite with cheerfulness to hold
> Its toiling labours through the sultry hour:
> So that same soothing Power, in misery,
> Cheers the poor pilgrim to eternity.

All the movements of ants are interesting, from the

time when they have simply a cavity in the earth, and commence the building of their little fabric, which daily increases in size. Here and there they leave cavities, where they intend to form the galleries which are to lead to the exterior, and during the day all the passages are kept open. The roof becomes convex, but not solid; for it is designed to include many apartments, or stories.

Scooping out the under portion of their dwelling, they form what has been called their "halls," low and heavy in structure, yet adapted to receive, at certain hours of the day, the caterpillars and chrysalises. There is a free communication in these halls by means of galleries. Were the materials loose, they would soon be thrown into confusion; but the earth is tempered by the ants with rain-water, and hardened in the sun. The substances composing the ant-hill are thus so compactly bound together, that certain fragments may be moved without injury to the rest: a defence against the weather is also secured by the same means. "I never found," says Hüber, "even after long and violent rains, the interior of the nest wetted to more than a quarter of an inch from the surface, provided it had not been previously out of repair, or deserted by its inhabitants."

The largest chamber, placed nearly in the centre of the building, is much loftier than the rest, and traversed

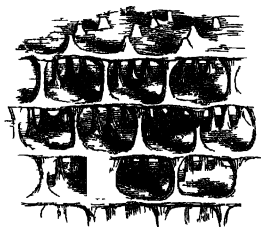
only by the beams that support the ceiling. In this spot all the galleries terminate; and this forms, for the most part, their usual residence. When the ant-hill is placed against a declivity, the whole interior may be seen by

A Nest of the Common Yellow Ant.

raising up the straw roof. The underground residence consists of a range of apartments excavated in the earth, taking a horizontal direction.

A friend of the writer's was recently walking in Stanstead-lane, Sydenham, when he observed a nest of the common yellow ant, built between the stems of wayside plants, and by their means partially suspended, as in the preceding engraving, over a stream of running water—a striking instance of constructive ingenuity

The title-page exhibits a singular nest formed on the branch of a tree, having a road made to it

The jet ant, on the contrary, always works in the interior of trees: on one side may be found horizontal galleries, which follow the circular direction of the layers

Galleries of the Jet Ant

of the wood; and on another, parallel galleries, separated by very thin partitions, having no communication, except by a few oval openings. Within the galleries separate chambers are formed pillars, too, appear—

first arched at both ends, and then worked into regular columns. Colonnades sustain the upper stories, and leave a free communication throughout the whole extent.

The wars of the fallow ants are very extraordinary. "I have witnessed," says Hüber, "the inhabitants of two large ant-hills engaged in a spirited combat; two empires could not have brought into the field a more numerous or more determined body of combatants." Of the same species, and so much alike, yet it rarely happens that two of the same side attack each other; and when this takes place, those which err for a time caress their companions with their antennæ, and readily appease their anger. Not only are they said to march, countermarch, retreat, and take prisoners, but they alter their plans according to various circumstances.

The rufous ant, a courageous, armed, and lazy insect, obtains servants by singular means: it seizes the caterpillars and chrysalises of the colony it attacks, educates them for itself in its own nest, and when they are perfect it employs them in its service. Many curious circumstances mark these expeditions. There is reason to think that these ants first send out spies, who describe the route to be taken. They push each other with the head or jaws, or play with the antennæ, perhaps to rouse

to effort, or tell what is about to be done. About five o'clock, in a warm summer afternoon, they start, eight or ten ants being usually in the advance; but no sooner do they pass beyond the nest than they move back, wheel round in a semicircle, and mix with the main body, while others succeed to their station. All in their turn pursue the same course; and after passing through the grass for about thirty feet, they disperse, and, like dogs on the scent, explore the ground with their antennæ. Soon they discover the colony of which they are in search: its sentinels dart upon the colonists with the utmost fury; crowds rush forth from their various avenues; but the besiegers compel them to retreat, and, by breaching the walls, or entering the gates, advance into the city. In a few minutes they appear again, each one carrying in its mouth a caterpillar or a chrysalis, and they return home the way they came.

Another fact, equally singular, is, that the ants keep and feed certain other insects, extracting from them a sweet and nutritious liquid, just as we obtain milk from cows. The milch cattle of the ants are the gall insects, and the aphides, or plant-lice. The latter insert their suckers into the bark of a tree, and thus absorb its sap, which becomes by digestion a fluid, scarcely inferior to honey in sweetness. When no

ants are near to receive it, the aphides throw it to a distance by a jerking movement which they give their bodies. When ants are present, they watch this movement, and immediately suck down the fluid. They know, too, how to milk the aphides, patting the abdomen, first on one side, and then on the other, with their antennæ, and eagerly drinking the little drop which issues forth. An ant having exhausted the milk of one aphis, goes to others, and when satiated returns to its dwelling.

Still more strange as it may seem, these milch cattle are not always considered the common property of a tribe of ants, but divided between two parties. The aphides on the branches of a tree or the stalks of a plant may be thus appropriated; and should intruders in any case appear, anger is manifest, and efforts are made to drive them away. It appears, moreover, that these milch cattle may be moved from place to place. Hüber observed some yellow ants, apparently very jealous of their stock, following them about, caressing them whenever they wished for the honeyed juice, which the aphides never refused, and removing them in their mouths to a place of safety on the slightest appearance of danger. Nor less careful are they of these little creatures than the husbandman of his flocks and herds.

White ants, so common in India and Africa, are very remarkable. When they gain possession of buildings, nothing less hard than glass or metal escapes their ravages. Wood is, however, their favourite food; and so great is the number of assailants, that all of it contained in a spacious apartment has often been destroyed in one night. The whole appears, indeed, outwardly untouched, but it is thoroughly sapped and mined—a shell ready to be crumbled into dust. Scarcely ever do they attack the outside of solid substances until they have first concealed it and their operations with a coat of clay.

A surveyor, having returned from a journey, left his trunk on a table; the next morning, not only were all his clothes found devoured, there being scarcely a piece as large as a shilling free from holes, but his papers also were destroyed, nor was a piece of them left an inch square. Some silver coin had on it a number of black specks, caused by something so corrosive that they could not be washed off even with sand, and the black lead of his pencils was consumed.

No sooner is a colony established than the female supplies it with a large population. Her abdomen increases, until it becomes fifteen hundred or two thousand times larger than the rest of the body; thus she equals in size

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twenty thousand or thirty thousand of her own subjects, and she sometimes lays her eggs at the rate of sixty in

Female Ant.

a minute, or more than eighty thousand in twenty-four hours. While this is being done, her chamber is a scene of great activity; crowds of attendants are passing and repassing to receive the eggs, and place them in the nurseries, where the young are supplied with food till they can procure it themselves.

The different species of white ants have abodes of very curious forms. Some erect on the ground a mushroom-like dwelling: a round turret of clay about three quarters of a yard high, and surrounded by a projecting conical roof: within are cells of much variety in figure and size. (See the engraving on page 23.) Others build their nests of pieces of wood glued together, from the size of a hat to that of a sugar-cask, amongst the branches of trees, often seventy or eighty feet high. Others are even more curious.

These dwellings are made of clay: they are generally

twelve feet high, and proportionably broad; and when appearing, as they frequently do, in a cluster, they

Nests of White Ants.

may be taken for an Indian village—sometimes, indeed, they are larger than the native huts. The building of these habitations is not a little curious: two or three turrets of clay, about a foot high, and shaped like a sugar-loaf, are first raised. They rapidly increase in number and height, until, at length, widened at the base, joined at the top into one dome, and fixed all round in a thick wall of clay, a building appears of the shape of a haycock, which, when coated, as it soon is, with

grass, it greatly resembles at a distance. The inner turrets, except the tops, which project from different parts of it like pinnacles, are now removed, and the clay employed over again in other ways.

Nests of White Ants

The inhabitants occupy only the lower parts of the building. The dome, which is very strong and solid, serves chiefly as a defence from the weather and the attacks of foes, and also to keep up beneath the warmth

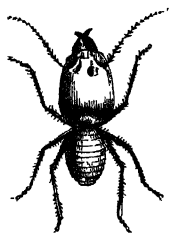
and moisture which are required for hatching the eggs and cherishing the young. In the centre appears the royal chamber—an arched vault, not unlike a long oven, at first not more than an inch long, but increasing, as the queen enlarges, to the length of eight inches or more. Here the royal pair always dwell, the entrances being too small for them to leave it. Next to this chamber, and entirely surrounding it, are what are called the royal apartments—arched rooms, of different shapes and sizes, opening into each other, or connected by passages, accommodating many thousand soldiers and attendants in waiting on the king and queen. Adjoining these are nurseries, filled with the young and the eggs; in the early state of the nest placed close to the royal chamber, but when the queen requires a larger apartment and more attendants, they are taken to pieces, rebuilt a size larger, increased in number, and placed also at a greater distance. The substance used in them is peculiar—particles of wood apparently joined together with gums. A collection of these irregular chambers, not one of which is half an inch wide, is enclosed in a common apartment of clay. Other rooms, or magazines, always well stored with provisions, are intermixed with the nurseries.

The magazines and nurseries, separated by small

empty chambers and galleries running round them, or communicating with each other, extend on all sides to the outer wall of the building, and almost to the top of it. They are, however, confined to the sides of the lower part of the hive leaving an open area under the dome. A flattish roof covers the top; and the area, which is a little above the royal chamber, has another, also waterproof, and so made as to let any rain that may chance to get in run off into the passages underground. Some of these are more than a foot in diameter, perfectly cylindrical, and lined with the same kind of clay of which the hive is composed. They slope to the depth of three or four feet, and then, branching out on all sides, are carried underground, near the surface, to a great distance. These are the great thoroughfares for the ants, by which they fetch their clay, wood, water, or provision; and they have a spiral and gradual ascent, because it would be difficult for these creatures to ascend a perpendicular. In some parts a flat pathway, half an inch wide, is often made to wind gradually, like a road cut out of the side of a mountain, by which they can easily travel, when otherwise it would be impossible.

There is another display of ingenuity to shorten labour. A kind of bridge, of one large arch, springs from the floor to the upper apartments, answering the

purpose of a flight of stairs. Thus the distance is greatly shortened in taking eggs from the royal chambers to the upper nurseries, which, in some cases, would be four or five feet in a straight line, and much more if carried along all the winding passages which lead through the inner chambers. One of these bridges was half an inch broad, a quarter of an inch thick, and ten inches long: it was strengthened by a small arch at the bottom, and had a hollow all the length of the upper surface, either made for the greater safety of the passengers, or worn by frequent treading.

Is not this an amazing work? Insects scarcely a quarter of an inch long, in the space of three or four years, thus erect a building twelve feet high, and proportionate in bulk, with all this variety of structure; making, too, efforts of ingenuity truly surprising. As Kirby says, "It far exceeds the most boasted works and structures of man; for did these creatures equal him in size, retaining their usual instincts and activity, their buildings would soar to the astonishing height of more than half a mile, and their tunnels would expand to a magnificent cylinder of more than three hundred feet in diameter; before which the pyramids of Egypt and the aqueducts of Rome would lose all their celebrity, and dwindle into nothing."

Soldier Ant.

We should not expect to find soldiers in such circumstances, yet such there are. Their duties appear to be, keeping a listless guard over the royal cell or the more active labourers, and defending the city. If the citadel is attacked, and a small breach made in the outer walls, the labourers become exposed to view; but these cannot fight, and so they at once retire, and give the alarm. A soldier now appears, in military phrase, to reconnoitre: this being done, he departs for a moment or two, and then returns with two or three others. Alarm forthwith becomes general; soldiers begin to pour out at the breach, their numbers being always proportionate to the injury done. These little creatures appear greatly enraged, but as they are blind they can take vengeance only on that which comes within their touch; they therefore move their heads about, stretching their long-pointed jaws to the utmost, ready to fasten on the first foe that comes in their way. When a stick has been put out, they have immediately fastened on it so firmly, that the jaws could not be disengaged without destroying the insect. How great, then, is the force which they can exert! As soon as the interruption has ceased, the sol-

diers retire; their place is then filled by labourers, who crowd the aperture, each bearing in his mouth a load of mortar half as big as himself; this he lays on the edge of the breach, and hastens back for more. An observer says, "Not the tenth part of an inch is left without labourers working upon it at the same moment; crowds are hurrying to and fro; yet, amid all this activity, we observed the greatest order—no one impeded the other, but each seemed to thread the mazes of the multitude without trouble or inconvenience." Meanwhile, the soldiers act as sentinels, walking in and out of the opening, with closed jaws and fearful mien. Every now and then, at the interval of a minute or two, a soldier makes a peculiar noise, by lifting up his head and striking his jaws against the wall of the dwelling, and immediately all the labourers, appearing to regard it as a signal for greater diligence or despatch, answer by a loud hiss, and by prompt obedience. Nor is the least remarkable fact, the rapidity with which the injured dwelling is repaired. A gallery of three or four yards in length has been restored in a single night. If, indeed, the nest were divided in halves, leaving the royal chamber—thus laying open thousands of apartments—all would be shut up with sheets of clay by the next morning. If even the whole were demolished, provided the

king and queen were left, every interstice between the ruins, at which either cold or wet could possibly enter, would be covered; and in a year the building would be raised to nearly its first size and grandeur.

We sometimes hear of inconceivable multitudes of white ants; and why, it may be asked, should they be thus abundant? To this it may be answered, God has made nothing in vain, and therefore we may rest satisfied that there are not too many. And here we might pause; but God has been pleased to encourage our confidence in him, when "his ways are past finding out," by instances in which reasons for his procedure are clear. The case before us is one of this kind. White ants are often used for food; thus, in some parts of the East Indies the natives make with flour a variety of pastry, which they sell at a very cheap rate to the poor. The Africans, too, skim them from the surface of the rivers, parch them in iron pots, and consider them delicious food. Smeathman, to whom we owe the greater part of our knowledge in reference to white ants, says, he has eaten them dressed in this way, and thinks them delicate, nourishing, and wholesome. They serve also another important purpose. Vegetation within the tropics is often pernicious: large trees falling would rot, and spread pestilence around, but multitudes of white ants make their

attack ; not a grain appears left, and plants injured by the shadow of trees of huge growth freely shoot forth.

Another provision of that God who is "excellent in working" ought not to be omitted. It is manifest that

The Maned Ant-eater.

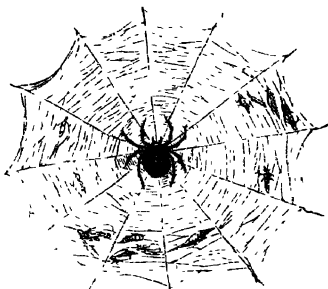
some creatures have been formed to make a prey of others, and thus to prevent their becoming too numerous. The engraving exhibits one of the destroyers of ants: it

lives where they abound, and taking them up on its long tongue—expressly adapted to this service, which it is said to be able to protrude and draw in twice in a second—it obtains food, and helps to prevent their increase being too great.

Who is there that devoutly studies animated nature, that is not continually delighted and instructed? But he can only do so as he walks by the light of Divine truth. There must be a looking to God as a Redeemer, or he will not be beheld in all his glories as a Creator. Why then, reader, should you not thus contemplate him? "He is able to save them to the uttermost that come unto God by Him, seeing he ever liveth to make intercession for them," Heb. vii. 25.

He who has rescued multitudes from ruin, who are now rejoicing in his blessings, is able and willing to save you. May, then, your language be—

> Jesus! reveal thyself again,
> That I may learn the rapturous strain:
> 'Tis not too much for thee to do,
> To change my heart and make it new:
> None can more need the aid Divine,
> And saved—no joy be more than *mine*.

THE SPIDER.

SPIDER IN ITS WEB.

THE SPIDER.

CHAPTER I.

SPIDERS—THEIR HABITS—WEB OF THE HOUSE SPIDER.

It is unhappily not uncommon for the young, and even for those of mature years, to be repelled by the sight of various natural objects. The spider, for instance, has often strongly excited the feeling of disgust; and yet this little creature, from which many at once shrink back, and which they could not be persuaded to touch, may well awaken attention, admiration, and astonishment. Despised as it may be, it is one of "the wonderful works of God;" and as we examine it, we shall find abundant reason to conclude, that were other creatures, exciting similar feelings, devoutly studied, such emotions would be banished, and we should adore Him whose hand they so clearly exhibit.

Let us look now at the movements of the spider. It can walk on the ceiling of a room, and on glass, as

that of a window, with its head downwards. This is said to be done by a brush on the foot, formed of slender bristles, fringed on each side with very fine hairs, and gradually diminishing in length as they approach its extremity, where they form a thick brush on the lower surface. These brushes were first discovered on the bird spider, and afterwards on other creatures of this kind. If one of them be taken, and the under side of the last joint of its foot be examined with a common pocket lens, it will appear clothed with a very thick brush.

Some spiders dwell peaceably together. A friend of the writer, when in Brazil, observed a large, and apparently a very mild and sociable spider, living with its companions in amity and good-will. When botanizing one day, in the neighbourhood of Rio de Janeiro, and passing among some trees, he found his head impeded, and on withdrawing it, his light straw hat remained, as if it were suspended in the air. It was entangled in the meshes of a curious cobweb, that stretched from the branches of opposite trees, and formed a large canopy over the place where he stood. The whole of it was covered with large spiders, having yellow spotted bodies, and shining polished legs. They were of different sizes and ages, and the colony consisted of above one hun-

dred insects, all living harmoniously together. Everywhere in Brazil, the intelligent observer referred to noticed similar webs covered with these spiders; nor did he see any sign of hostility.

It is even stated that a prisoner in the Bastile tamed a spider, and taught it to come for food at the sound of an instrument; and that a manufacturer in Paris fed eight hundred spiders in an apartment, which became so tame, that on his entering it, which he often did, though not always, bringing a dish filled with flies, they immediately came down to receive their food.

Spiders, it may be remarked, have been divided into *hunters*, wandering incessantly to entrap their prey; *vagrants*, concealed or enclosed in a nest, watching their prey, but often actively running; *sedentaries*, or weavers, remaining motionless in a web which they have formed; and *swimmers*, their nets being on the water, where they pursue their prey. We shall attend to some specimens of each of these.

The celebrated Evelyn says, in his "Travels in Italy:" "Of all sorts of insects, none have afforded me more divertisement than the venatores, (hunters,) which are a sort of lupi, (wolves,) that have their dens in rugged walls and crevices of our houses; a small brown and delicately spotted kind of spiders, whose hinder legs

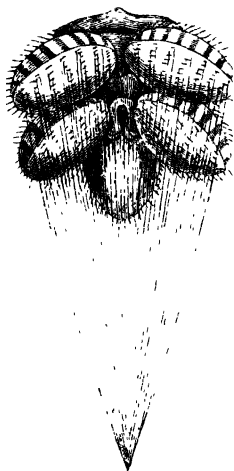
are larger than the rest. Such I did frequently observe at Rome, which, espying a fly at three or four yards' distance upon the balcony where I stood, would not make directly to her, but crawl under the rail, till, being arrived at the antipodes, it would steal up, seldom missing its aim; but, if she chanced to want anything of being perfectly opposite, would at first peep, immediately slide down again; till, taking better notice, it would come the next time exactly on the fly's back: but if this happened not to be within a competent leap, then would this insect move so softly, as the very shadow of the gnomon, (the hand of a sun-dial,) seeming not to be more imperceptible, unless the fly moved; and then would the spider move also in the same proportion, keeping that just time with her motion as if the same soul had animated both these little bodies; and whether it was forwards, backwards, or to either side, without at all turning her body, like a well-managed horse; but if the capricious fly took wing and pitched upon another place behind our huntress, then would the spider whirl its body so nimbly about, as nothing could be imagined more swift,

The Hunter.

by which means she always kept the head towards her prey, though to appearance as immovable as if it had been a nail driven into the wood; till, by that indiscernible progress, (being arrived within the sphere of her reach,) she made a fatal leap, swift as lightning, upon the fly, catching him in the pole, where she never quitted her hold till her belly was full, and then carried the remainder home."

Some species among those named vagrants conceal themselves in a little cell, formed of the rolled-up leaf of a plant, and thence dart on any insect which may happen to pass. Others select a hole in a wall as a place of ambush, or lurk behind a stone, or in the bark of a tree. Others resort to a singular device: the spider placing itself at the bottom of a flower-cup, seizes the unwary flies that visit it in pursuit of honey; other manœuvres are often practised, such as hiding behind any slight projection, or pretending to be dead.

The material employed by the sedentaries, or weavers, is not a little remarkable. The thread of the spider, like that of the silkworm and other caterpillars, is originally a glutinous secretion drawn out from the body of the insect. If a spider be minutely examined, several little teats or spinners will be observed; each of these contains a great many tubes, so numerous

and so fine, that a space which is often no bigger than the pointed end of a pin, is said to be provided with a thousand of them. From each of these tubes, consisting of two pieces, the last of which has an exceedingly fine point, an amazingly slender thread proceeds, which immediately after unites with all the other threads into one. Thus from each spinner there issues a compound thread; and these four threads, at about a tenth of an inch from the point of the spinners, again unite, and form the cordage of the spider's web.

Thread of the Spider.

Reaumur states that he has often counted, through a microscope, seventy or eighty fibres in a single thread, observing, at the same time, that they were too numerous for him to reckon them. He considered himself far within the limits of truth, in computing that a single thread of a spider's web is composed of 5000 fibres!

Delicate, indeed, is the cordage of this web; what, then, are the instruments used in producing it? These are only the claws of the spider's feet; with these it guides and arranges the glutinous threads, as they are drawn from the spinners.

A species related to the garden spider has eight claws, seven of which have their lower side toothed. These enable the creature to take hold of any thread; to guide it, to pull it, to draw it out, to ascertain what is caught, and to suspend itself. On the legs, and especially the last three joints, movable spines or spurs may be observed, which can be raised or depressed at the will of the spider, and are probably used when wanted as a kind of fingers.

Claws of the Spider.

The number of fibres of which a single thread is formed contributes greatly to its strength. Rope-making is an imitation of this process; and, as the engraving shows, the end of a thread, by being spread out, is made to grasp more firmly the object to which it is attached.

Ends of Spiders' Thread.

The web of one of the weaver spiders is produced by a double series of spines, planted on the first joint of one pair of feet. These spines are used like a carding apparatus in manufactories, the lower series combing, as it were, the ravelled web from the spinneret, and the upper series disengaging the web from them. In this curious way the adhesive part of the snare is formed.

Nor is this all; the spider has often to ascend by the line which has enabled it to drop from a height on the ground, and it then winds up the line as it proceeds, into a little ball. In so doing, the comblike claws are not used, but a third claw is employed; this is placed between the two, and appears to be expressly provided for such an operation.

The threads which serve only to form the web as a snare to catch prey, are very fragile; but there are threads of another kind. They are used to enclose the eggs of the female as a shelter from cold, and a defence from other insects, and are therefore much stronger. When first formed, the colour of these threads is grey, but the air gives them a blackish hue.

A singular experiment was made by M. Bon. He collected the bags which spiders of the common sort of the short-legged kind make for their eggs in some place sheltered from the wind and rain, and formed from them

a new kind of silk. It was of a peculiar ash colour ;. it readily took all kinds of dyes; it was spun without difficulty; it was asserted to be both finer and stronger than common silk; and of it stockings and gloves were actually made, some of which M. Bon presented to the Royal Society of London, and others he transmitted to the Royal Academy of Paris.

The common house spider produces a close tissue or web, composed of fibres crossing each other in various directions, found, as is well known, in corners of rooms, barns, stables, out-houses, and other situations. The mode adopted by this insect is worthy attention. Having chosen a place for the web, and arranged its general plan and dimensions, the spider dexterously affixes the first thread, which is to form the edge or selvage, to one of the walls or some other convenient point; and then, drawing out its thread, it forthwith proceeds to the opposite wall or point, and there fastens it also. This process is then repeated several times, that the threads may be redoubled, to give due strength to the margin of the web, which will have to bear considerable stress.

The margin being formed, the spider next proceeds to draw threads in all directions, crossing and recrossing them, until every interval being filled up, the web appears

to have an irregular gauze-like structure, stretching horizontally from point to point, or filling a convenient angle. In addition to this web, other lines are often carried up from its edges, so as from a maze of cordage to form a snare to the rambling and heedless fly, for whose destruction it is spread.

But where shall we find the little but grim artificer? Patiently lurking in its hiding-place—a chamber covered with a close tissue of web in some remote corner, concealed from passing view, yet close enough for all its purposes. Leading to its den are a number of threads, which vibrate when a fly is caught, and thus apprize the spider of the booty within its grasp. As a sailor glides from the top-mast, so it hastens to its struggling victim. If within the compass of its strength, the spider begins the attack at once, and plunges its venomous jaws into the body of the helpless captive; but if the prey be large and powerful, and likely to break through the meshes thrown about it, a more cautious mode is adopted: a cordage of threads is instantly lashed around the captive.

> The fluttering wing,
> And shriller sound, declare extreme distress,
> And ask the helping, hospitable hand.

When this is not near, the prey is left enchained, till,

wearied with unavailing struggles, it becomes an unresisting sacrifice to the cunning of its foe.

It has already been stated that some spiders live amicably together; but there are not wanting facts to show that they will sometimes devour their own species. Some spiders, however, may be turned to a useful purpose. One kind, that makes no web, destroys great numbers of cockchafers. Some of the former have, therefore, been taken on board of ships when infested by the latter, just as cats are employed to destroy rats. "In my cabin," says an intelligent writer, "half a dozen very large spiders had established themselves: they at first rather startled me, as their bodies were nearly as large as walnuts; but they were so active in doing their duty, that I was soon reconciled to them. Whenever a big, buzzing cockroach came to pounce on my provisions, like a harpy, the vigilant sentinel immediately darted on him, and made him a prisoner."

The destruction of animal life, however, is a fact on which it may be well to offer a passing remark. This is proceeding in circumstances which we are likely to overlook. Though many animals feed only on vegetables, yet even they consume multitudes of minute creatures. They do not, however, extirpate any race of animalcules, but merely prevent too great an increase.

The same law operates in other circumstances. The aggregate of living creatures are the devourers of others. Thus the spider finds a prey in the fly, and will even destroy its own species. Birds, fishes, and reptiles also feed on insects; the boa gorges the antelope, and the rattle-snake the squirrel. But in the destruction that is thus carried on, wisdom and goodness may alike be perceived. No race is destroyed, whatever be the ravages it suffers. The effect is only that of keeping every species within the bounds most desirable. If, on the one hand, there is destruction, on the other there is renovation; and thus the purposes of the Great Supreme are accomplished. Were there only one, serious evils would arise; the operation of both is productive of harmony, maintaining as it does, most beneficially, the proper balance of animal existence.

The spider is rarely mentioned in the sacred volume. One passage occurs where Bildad displays the justice of God in punishing the hypocrite, "Whose hope shall be cut off, and whose trust shall be a spider's web. He shall lean upon his house, but it shall not stand: he shall hold it fast, but it shall not endure." Job viii. 14, 15. All the professions and doings of one who only pretends to be righteous, without the principles of true piety, are frail and unstable as the spider's web. Though curiously

wrought, they are soon destroyed ; and so the expectation of the hypocrite shall perish. How important it is, then, that he who writes, and those who read, should search and try their ways by the unerring word of God, earnestly entreating that their hearts may be made right in his sight, and their feet sound in his statutes. It is only in union to Christ, by the operation of the Holy Spirit, that there can be "a good hope"—"a good hope through grace"—a hope which is "an anchor to the soul, both sure and steadfast"—a hope which "maketh not ashamed." The believer may therefore say :

'Tis sweet to rest in lively hope,
  That when the change shall come,
Angels will hover round my bed,
  And waft my spirit home.

There shall my disimprisoned soul
  Behold Him, and adore ;
Be with his likeness satisfied,
  And grieve and sin no more.

Shall see him wear that very flesh
  On which my guilt was lain ;
His love intense, his merit fresh,
  As though but newly slain.

Soon, too, my slumbering dust shall hear
  The trumpet's quickening sound ;
And by my Saviour's power rebuilt,
  At his right hand be found.

CHAPTER II.

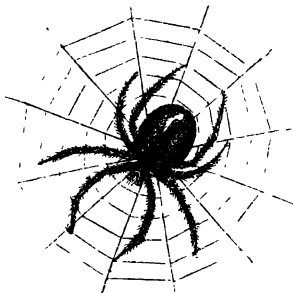
THE GARDEN SPIDER AND ITS WEB—THE GOSSAMER SPIDER AND ITS BALLOON—SINGULAR STRUCTURES OF OTHER SPIDERS—SPIDERS' EGGS.

THE geometric spider of our gardens is as remarkable for the beauty of its markings, as it is for the lightness and filmy delicacy of the webs it constructs. On a fine autumnal morning, an observer of nature will not fail to notice its threads and circular net, laden with pearly drops, hanging profusely along every hedge-row and on every bush; nor, at the same time, should he forget that great and condescending Being who has taught

> The wild bird how to build its nest,
> The insect weave its web.

Let us look at the course pursued in this instance. The spider first forms the outline, which it does by passing from one leaf or sprig to another, fixing its threads as it proceeds, and thus encircling a considerable space. The outline has additions made to it, until it becomes sufficiently strong; the whole being kept properly tight by securing the line to various

objects. The outline is now filled up by lines, which are like spokes to a wheel; to do this, the spider fixes a thread to a convenient part of the outline, which it traverses till it reaches the opposite point to that where the thread was thus placed; all this time drawing out its line, and keeping it distinct by one of its hind feet, so as to prevent its being glued to the thread along which the spider walked; and this thread, crossing the middle of the space, it now makes fast. It then begins at the middle of this cross-thread, where it fastens another, carrying it to the nearest part of the outline, to be there secured. From the same spot, which is to be the centre of the net, it now carries a thread to the outline, and so on, until the number of lines, or spokes, generally from twenty to thirty, is completed. Having become sure that every thread is strong enough, by pulling at each separately, and replacing such as are found faulty, it next proceeds to form the concentric circles—those from the centre to the outline. Beginning at the centre, it spins a ring, fastened to each spoke at a little distance from the centre point; this is followed by more at a very small space from each other, the interval increasing as the spider approaches the circumference. The whole of these circles being finished, it returns to the centre, and

bites off the point at which all the spokes were united, so as to make their security depend on the circular threads alone, and most probably rendering the net more elastic. In this central spot the spider sometimes takes its station on the watch for prey; but it always spins a cell in a retired spot, in which it may lurk unobserved. The vibration of the threads from its retreat to the centre of the net, serves to tell it when any prey is taken.

The Garden Spider finishing its Web.

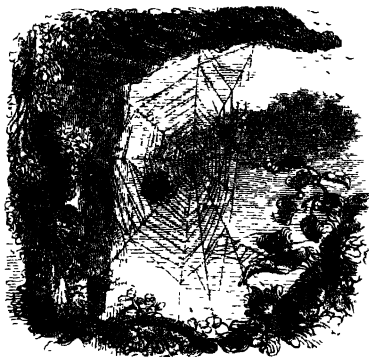
Another curious fact, not yet noticed, is, that there are long lines stretched to distant points, which the spider could not have visited. Sometimes they pass from one branch to another, at others from the web to distant branches. They have been observed some yards in length, passing from a hedge-row to trees at a considerable distance, and at various heights from the ground.

The lines so singularly produced are traced to spiders always availing themselves of currents of air, by which their threads are sometimes carried to a sur-

prising distance. If one of these insects be placed on twigs set upright in glazed earthen vessels, with perpendicular sides, and containing some water, it will use every means in its power to escape—all its efforts usually proving unavailing in a still atmosphere. But when exposed to a current of air, or when gently blown upon by the mouth, the spider immediately turns the lower part of its body in the direction of the breeze, and emits from the spinning apparatus some liquid gum, which being carried out in a line by the current, becomes connected with some neighbouring object. This the insect ascertains by pulling at it with its feet, and drawing it in till it is sufficiently tense, the spider gums it fast to the twig, and passing along it, speedily regains its liberty. Spiders have been frequently observed in their natural haunts, resorting to the same means for changing their situation, and laying the foundation of their snares.

This solution, apparently satisfactory as it is, requires, however, to be confirmed. Another writer asserts, that one spider can propel its threads horizontally and vertically, and at all angles, in motionless air, or in an atmosphere agitated by winds; nay, more, can dart its thread, to use a nautical phrase, "in the wind's eye." As the result of hundreds of experiments, he considers these

effects electrical. The mode pursued in such cases is very curious, and some things connected with it are not yet understood.

It has been supposed that the garden spider is the one to which Solomon referred when he described it as

Spider in a Garden.

"exceeding wise," and said, "The spider taketh hold with her hands, and is in kings' palaces," Prov. xxx. 24, 28. How curious are the circles it forms! skilfully, too, does it pull out its thread with its feet; while the stays it makes to give stability to its structure, show what in other creatures is called great sagacity.

It is worthy of remark, that the Chinese have noticed

the skill of the spider in choosing a proper place for its nest, and in defending it from the assaults of the wind. They apply to it one name expressive of the pearl-like roundness of the body, and another which literally signifies the wise insect.

In one of their books they mention a spider which haunts houses and streets, and say it is never found among herbs. This agrees with the character of our domestic spider, and might seem to be that insect, were it not described as spotted with red, which shows it to be one of the kind just referred to. They also say that the web resembles a fishing-net suspended from four posts, and capable of being raised and depressed by means of lines. This description also suits the web of this species, which, though nearly vertical, is suspended by lines from different points.

In the streets of Canton, this spider has been frequently seen by a modern traveller resting on the centre of a circular net, which reached across the street: it had so placed its net as to be secure from man, since it was far above his reach as he walked beneath. It could not be assailed from a window, as the front of buildings in that city have no such accommodation. Here, on a fine silky web, it rested, while its large round body reflected a variety of the liveliest colours; nor was its

repose disturbed, until a fly fell into its toils. Then it would suddenly awake, seize its prey, bind it fast, and afterwards return to the centre of the nest to resume its slumbers.

The same observer has mentioned an instance of instinct which fell under his own notice. One of these spiders, while resting in the middle of the web, was visited by another, who, being afraid to approach at once, gave notice of its coming by pulling some of the threads. It appeared, however, that the visit was not acceptable, for the new-comer was rudely dismissed. On returning to the centre of the web, the spider carefully pulled the threads which the intruder had touched, to ascertain whether they were moved from their places.

The expression of Solomon that "the spider taketh hold with her hands," is not a little remarkable. Some writers have asserted, that, as the spider has no hands, this insect could not have been meant by the wise king of Israel. Other creatures having such members have, therefore, been supposed to be referred to. Such a course is often taken, but it never should be without the most satisfactory reasons. We should first be concerned to make out what the word of God really says, and then to take it just as it is.

But the original word used by Solomon signifies to

handle or play upon, as men do on a harp; and thus the movements of the spider are compared to the fingers of a musician, who, from the skill with which he is endowed, brings out from the strings an harmonious result. Is there not a resemblance in this to the spider? and are not all its movements which we have been considering most appropriate and admirable?

The Gossamer Spider.

Thread may often be observed in England floating in the air, and stretched across a road or brook. It is produced by the gossamer spider; for, having no wings wherewith to fly, nor the power of darting, like some other insects, a considerable distance, this little creature is enabled to form a balloon, with which it can rise to a great height. In this aërial navigation, the little creature floats with its back downwards, and its legs folded; and thus reposing at its ease, upborne by streamers of silken

threads, it commits itself to the upper air. One naturalist states, that when he ascended York cathedral, he saw these insects above him.

The films produced by this spider are, in some cases, very numerous. It is stated by a gentleman, who was at Lisbon in November 1811, that on one day, the Tagus was covered for more than half an hour by these webs, and that they were accompanied by innumerable spiders swimming on the face of the water. A similar shower was observed by Mr. White, of Selborne in Hampshire, in September 1741. The whole face of the country was covered with a coat of web drenched with dew, as thick as if two or three setting nets had been drawn one over the other. The dogs he took out with him were so blinded by these films, as to be obliged to lie down and scrape themselves. About nine in the morning, the films, some of which were an inch broad and six long, fell from a height, and continued to do so the whole day.

A very curious web is constructed by a species of hunting spider, found in Egypt, Dalmatia, among the mountains of Narbonne, and the Pyrenees. It fixes on the under surface of large stones, or the clefts of rocks, a dwelling in the form of a hood or bowl, of a full inch in diameter; its circumference is seven or eight inches,

of which only the angles are fastened on the stone, by bundles of threads, while the edges are free. Admirable is the texture of this singular tent; the exterior resembles the finest taffeta, and consists, according to the age of the spider, of a greater or smaller number of layers. Thus, when as yet young, and beginning to form its retreat, it forms only two webs, between which it takes up its abode. Afterwards, it is thought, at each moult, it adds a certain number of layers; and at the proper time, it weaves an apartment more downy and soft than any preceding one, wherein to shut up its sacks of eggs, and its recently hatched young.

The outer hood or tent-cloth may be designedly more or less obscured by foreign particles, which serve to disguise its appearance; but the dwelling of the spider is always delicately neat and clean. The pockets or bags which enclose the eggs are four, five, or even six in number in each dwelling; they are made of taffeta, white as snow, and lined with the finest down. The laying of the eggs does not take place before the end of December, or the beginning of January; the young have, therefore, to be defended not only from the inroads of enemies, but the rigour of the season. But full provision is made against every evil. The pocket is always separated from the web in contact with the stone by a layer of

soft down, and from the outer envelope by many folds. Among the niches which border the tent, some are closed by the web being continuous, but others have their edges simply wrapped over, so that the spider by raising them can leave or enter its tent at pleasure. When it goes abroad to hunt for food, it need not fear the violation of its dwelling, possessing, as it alone does, the secret of the niches, and the key of those which serve for ingress.

As soon as the young are of sufficient age to dispense with the cares of the parent, they take their departure, and go elsewhere to form their separate abodes, while the mother dies in her tent. This is not an engine in which to entrap its victim, like the web of the house spider, nor is it like the filmy net-work of other insects; it is merely a dwelling-place: different means are employed for the capture of its prey.

Some species show great skill in building in ways not yet mentioned. They hollow out cells; they bore galleries; they make vaults; they build, as it were, bridges; they construct entrances to their habitations. They even adapt doors to these entrances, which want nothing but bolts, for they are fitted to a frame, and work on a hinge. On looking within, we find extreme neatness. The soil in which these dwellings are found may be humid,

but no water can enter them. The walls are nicely covered with a tapestry of silk, having usually the lustre of satin, and almost always a dazzling whiteness. Another singular nest is formed by the zebra spider.

The Zebra Spider, and its Nest.

Some insects choose a kind of red earth, in which they bore tubes about three inches deep, and ten lines wide. The walls of these tubes are not left just as they are bored, but are covered with a kind of mortar. If

Singular Nest

the tube is divided lengthwise, besides this rough coat, it seems to be covered with a coat of fine mortar, which is as smooth and regular as if a trowel had been passed over it. This coat is very thin and soft to the touch; but before the spider makes it, she covers the coarser earthy plaster-work with some coarse web, on which she glues her silken tapestry.

To guard against intrusion, a very secure trap-door is made, to close the mouth of the tube. At first sight, the nest appears a mass of earth coarsely worked, and covered within by a solid web. But divided vertically, it will prove to be formed of more than thirty alternate layers of earth and web, placed one in the other like weights used for small scales.

Nor is this all; all the layers of web terminate in the hinge, so that the thicker the door the more powerful the hinge. The frame in which the tube terminates above, and to which the door is adapted, is thick, and its thickness arises from the number of layers of which it consists, and which seem to correspond with those of the door. How complete and remarkable are all these arrangements!

Only let an observer for example, skilfully pass a

pin under the edge of the door, and raise it a little, and immediately he will find that strong resistance is made. This is put forth by the little inhabitant. Warned by the vibrations of the threads, which extend from the door to the bottom of the gallery, the spider runs hastily to the door, fastens its legs to it on one side, and on the other to the walls, and, turning on its back, pulls with all its might.

A Cavern-maker.

When this effort is vain, the little creature seeks safety in flight. Should the door now be fastened down, so that it cannot be forced open, the observer will see, next morning, a new entrance, with a new door formed at a short distance; and if the door be removed, another will be made in less than twelve hours.

The species in the habit of forming this remarkable abode, for it is not at all used as a snare, are not uncommon in the south of France. Similar galleries are made by many tropical species. "I have seen one of these which had been dug out of the earth," says Kirby; "it was nearly a foot in length, and above an inch in diameter, forming a cylindrical bag of dark-coloured silk, closed at the bottom, and accurately fitted at the top by a door or lid."

There is a nest, if possible, more extraordinary still: it is formed of air, and that in the midst of water! The little builder first spins loose threads in various directions, attached to the leaves of aquatic plants, and over them it spreads a transparent and elastic varnish resembling liquid glass. Next it spreads over its belly a pellicle, or bladder, of the same material, and rises to the surface of the water. Here receiving air, probably, by one part of its body, it transfers it by another part to this pellicle; and then plunging to the bottom, it introduces a bubble of air beneath the roof so skilfully made. Repeating the effort ten or twelve times, the air thus collected and conveyed is sufficient to expand to the proper extent the little chamber. Here the spider rests and devours his prey in safety, undisturbed by the storms which agitate the surface of the water. This spider is one of the largest European species, and is not uncommon in the stagnant pools of some countries.

A very large spider has been observed in the fen-ditches of Norfolk, which forms a raft to secure its prey more easily. Stationed in a ball of weeds about three inches in diameter, and probably held together by slight silken threads, the creature is wafted along on the water. When it sees a drowning insect, the spider quits its raft,

seizes its booty, and devours it at leisure on its ball of weeds, under which, when alarmed, it takes refuge.

We have now only space for some curious facts in reference to the eggs of spiders. Looking first at the size of the insect, and then at that of the eggs, it appears difficult to imagine how they can be contained in so small a body. But watch them closely, and you will find that the shell is not hard like the eggs of birds, but soft and yielding. They lie, therefore, in the egg-bag, flat and squeezed together, and only come into a globular form after they are laid, from the equal pressure of the air on every side, just as dew-drops and globules of quicksilver are formed from the same cause.

It is worthy of remark, that the eggs of spiders are generally placed, though not always, in a roundish ball—perhaps, as a good reason always operates in nature, to economize the materials of the silken web, which the mother spins around by way of protecting them. In making the ball, the mother-spider uses its own body to measure its work, in the same way as a bird uses its body to gauge the size and form of its nest. It first spreads a thin coating of silk as a foundation, turning its body round to make it circular. In the same manner, it then spins a raised border round this, till it takes the form of a cup, and begins to lay its eggs

in the cup, filling it to the brim, and even piling them up above it into a rounded heap, as high as the cup is deep. But, mark, the under half is covered and protected by the silken sides, but the upper is still bare, and exposed to the air and the cold. The spider proceeds to cover these, weaving a thick web of silk all around them, and enclosing all the eggs in a ball much larger than the body of the insect that formed it.

The spider is provided with singular means for placing the eggs in a proper position, which are excluded from a cavity just behind the breast. It is an instrument somewhat like a hook, which the spider can move so as to place each egg in the spot it prefers. In this the sense of touch must be very acute, as by touch it must be wholly guided. The eyes of the spider, though very piercing, and eight in number, are in the upper part of the head, and cannot be brought within sight of the nest.

Thus wonder arises at the arrangements of God, even for the spider, so often regarded with contempt and disgust; and as we turn from object to object in the natural world, and study it with the emotions which ought to be called forth, it becomes us to offer the tribute demanded also by providence and redemption— "He hath done all things well!"

THE GALL INSECT.

GALL OF THE WILD ROSE.

THE GALL INSECT.

CHAPTER I.

FORMATION OF GALLS—THEIR GREAT VARIETY—GALL OF THE VIOLET—THE APPLES OF SODOM—THE OAK GALL OF COMMERCE—OUR OBLIGATIONS TO INSECTS—EFFORTS TO BE USEFUL.

In looking at any production of human art, which we have not before beheld, there is no security against our being disappointed. The contrary is the case with every object God has made. However humble it may appear, it is worthy of the infinite Creator; and in proportion as it is devoutly studied will his skill be manifest.

The insects now to be considered recall this fact. Though, unhappily, little known, yet when they receive due attention, they bring before us a most interesting provision for inferior creatures, the peculiar and admirable means by which it is secured, and its subserviency in various ways, to the advantage of mankind.

Each gall insect is provided with an auger, nicely

adapted in form to the body, and also to freedom of motion. It might be supposed, at the first glance, to be simple, but this is not the case. It is hollowed; and the end has small teeth, like the iron point of an arrow; and with these the insect enlarges the notches it makes in different parts of vegetables, in order to lay its eggs there. The juices of these vegetables expanding through the vessels which are thus opened, form an excrescence, which is called a gall, in which the egg is inclosed, and from which a caterpillar comes. The young insects find in their abode the means of support; they suck and gnaw the interior of the gall, which grows and becomes solid in proportion as they eat the interior Is there not then, in this case, much to demand our admiration?

Auger of the Gall Insect magnified.

It is well to observe here, that there are false galls, which are equally common with those already described. They are found on a great number of plants, and some are very remarkable both for size and abundance. They are seen, however, on fewer parts of the plant or tree

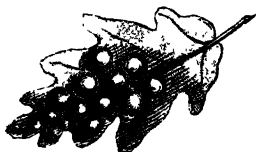
than the true galls, being almost wholly confined to the leaves or flowers, or the neighbouring and delicate parts. Hollow, reddish protuberances may be observed growing in abundance on the branches of the elm, and sometimes entirely covering them. These are the productions of a different class of insects; and, when young, they are only inhabited by a single female insect. In the middle of summer, however, hundreds of insects find there an abode. Sometimes these galls are entirely closed; at others, there is a communication with the exterior.

Among the gall insects, properly so called, there is great diversity, but a likeness is discoverable in one respect. All of them lay an egg under the outer covering of a plant, and on this a substance is formed, in which the inmate may dwell, and from which it may derive its support.

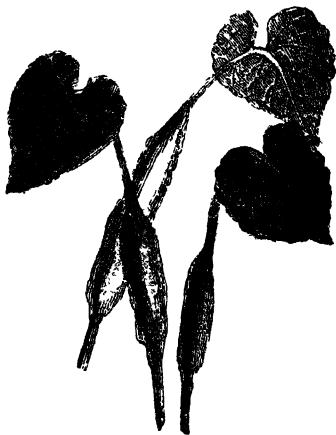
Galls may be found in every part of a plant. Roots, branches, leaves, and even buds, are thus invaded; as the space required, in different circumstances, varies greatly. Some galls are not larger than the head of a pin, others are of considerable size. Some galls are juicy, and others extremely hard. This variety seems dependent on the pleasure of the insect. On the same leaf one insect will produce a gall of the former, and another that of the latter kind. Many galls have a

cavity, shutting up a certain number of caterpillars living in society. Others have many small cavities, between which there are communications. In some cases, more than a hundred cells may be observed, each of which contains a single caterpillar. Other species of galls have but a single cell, inhabited by a caterpillar, which lives alone.

The majority of galls increase in size very rapidly. Those of the largest species grow in a few days, and even, as it appears, before the caterpillar issues from the egg; so that when it does so its lodging is ready made, and requires no further increase. These little creatures grow very fast, but they remain in the gall five or six months. Some pass into the chrysalis state in the gall, from which they escape in the perfect form, after making a small hole in it. Others quit the gall to enter the earth, until they have reached the perfect state.

A very simple and common form of these nests for the young may be observed on the leaves of various trees during the summer months. A berry-like substance, of a green colour, tinged with red, may be seen in the willow, the poplar, and the rose-tree. Let one of these

Galls on a Leaf.

be cut open, and it will be found the dwelling of an egg or a caterpillar.

Nor is winter without instances of a similar provision for inferior creatures. There is, for example, an insect which feeds on the sweet violet, and is defended in a remarkable manner from cold, external enemies, and injuries by means of a gall. Some time in the summer,

Galls on the Leaf-stalk of the Violet.

or autumn, the parent insect lays its eggs on, or in, a growing shoot of the violet; and when these are hatched,

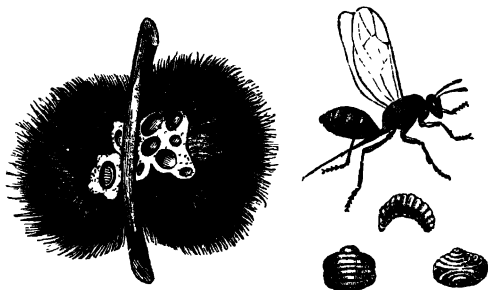
the caterpillars cut their way into the soft parts of the plant, which, having its juices there interrupted, bulges out around the little creatures, and there they find an abode. Here they live, secure of plenty to eat, during the coldest weather; and when the summer comes, make their way out as perfect insects. There are, also, winter retreats for caterpillars in many other plants often contrived in a very different manner.

Galls present great varieties of form. The most common ones are rounded. Some have received, from their colour and figure, the names of certain fruits which they resemble. Some found on the oak are called apple, gooseberry, or pippin galls. Some are like fruits in their spongy texture. Among those which are of a round form, some are fixed upon the plant, others only hold there by a short stem.

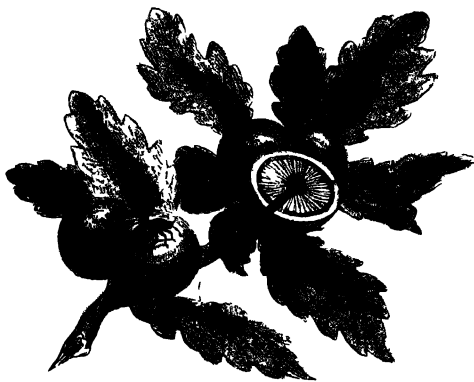
Currant Galls.

Some galls appear to be a portion of the plant tumefied

and thickened; such are those observed on the willow and osier. Various vegetables, and their different parts, exhibit galls differently figured.

There is a species of fibrous gall which is very remarkable. It is as large as an apple, and is covered with long reddish threads. It appears on the eglantine, or wild rose, which sometimes bears three or four of these galls. A representation of the exterior of one of these appears on the title. The following engraving is still further

Interior of the Gall on the Eglantine; the perfect Insect, showing the Auger: and three representations of the Caterpillar.

illustrative. The same shrub presents a still rarer species. It grows at the end of its branches, where it forms a mass composed of a dozen little galls, of various forms. These two species owe their origin to the same insect.

The gall of the ground-ivy, the sage-gall, and the birch, might here be described; but we only notice now the gall of the field-cirsium. It is merely an enlargement of the stem of that plant, and was formerly in high repute, because when carried in the pocket it was considered a sovereign remedy against bleeding, a virtue which it was said to owe to its likeness to the principal sign of this disease, the swelling of the vein! How deeply to be deplored is such ignorance! How thankful should we be for the instruction we enjoy

Oak Apples.

The oak has the greatest number of galls. Some

have the form of little apples, detached or united; others are prickly; some are branched, and others resemble little artichokes or mushrooms. Some leaves are laden with little rough galls, which appear like buds. Other leaves of the same tree have galls which resemble a small open goblet; these are flattened, even, or crisped. Some are woody, and others spongy, according to the substance in which the eggs have been placed.

The reader has, perhaps, met with some account of the far-famed apples, growing

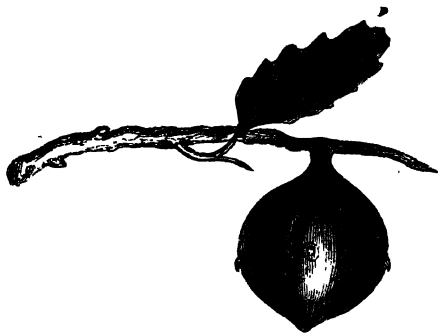
"Near that bituminous lake where Sodom stood."

Tacitus and Josephus mention this fruit as beautiful to the eye, but crumbling at the touch to dust and bitter ashes. Since their day, the statement has been considered by some unfounded, and others have accounted for its being made in various ways. One writer considered the apples referred to, to be pomegranates, which having a tough hard rind, and being left on the trees two or three years, the inside becomes dried to dust, while the outside remains fair. Another supposed this fruit to be that of a species of cotton tree. A third tells us, that the shrub which bears it grows two or three leagues from the mouth of the Jordan; that it is thorny, with small taper leaves, and that its fruit is

exactly like the little Egyptian lemon, both in size and colour. "Before it is ripe," he says, "it is filled with a corrosive and saline juice; when dried it yields a blackish seed, which may be compared to ashes, and which in taste resembles bitter pepper." Of these fruits, he gathered half a dozen. A fourth traveller found in a thicket of brushwood, about half a mile from the plain of Jericho, a shrub five or six feet high, in which grew clusters of fruit, about the size of a small apricot, of a bright yellow colour, which, contrasting with the delicate verdure of the foliage, seemed like "the union of gold with emeralds." And he adds, "Possibly, when ripe, they may crumble into dust upon any violent pressure."

The marvellous fruit, which has led to so much discussion, appears, at last, however, to be the work of an insect—one of the gall-makers which we are describing. Some specimens have lately been brought home by a traveller in the Holy Land; and of one a representation is annexed.

The tree which produces these galls grows in abundance on the mountains in the neighbourhood of the Dead Sea, and is about the size of our apple trees. When on the tree, they are of a rich purple, and varnished over with a soft substance of the consistence of

honey, shining with a most brilliant lustre in the sun, which makes them appear very delicious and tempting.

Apple of Sodom.

On a small quantity of one being tasted, it proved the strongest of bitters; in fact, as bitter as gall.

The gall is pear-shaped, with a circle of small sharp-pointed protuberances on the upper part of it, which appear to be formed for air or defence; it may be for some other purpose. In each of the galls there is an opening, through which the insect escapes from a small round hole in the centre, where it is lodged.

Many galls are merely objects of curiosity; but there

is one of great value, well known in commerce. It is abundant in Asia Minor, Syria, and Persia. These galls

Oak Galls of Commerce.

have no smell, but a bitter and astringent taste, and are much used in the manufacture of ink. They are nearly round, and vary from the size of a pea to that of a hazel-nut. When good, they are of a black or deep

olive-colour. They are heavy, brittle, and break with a flinty fracture. They are known in commerce by the names of white, green, and blue. The white are those which have not been gathered till the insect has made its escape; they are not so heavy as the others, are of a lighter colour, and do not fetch so high a price. The green and blue galls are gathered before the escape of the insect; they are heavier and darker than the former, and are said to yield about one-third more of useful colouring matter.

How greatly are we indebted to the little creatures, which enable us to converse with our absent friends and connexions, be their distance ever so great! The human voice can be heard commonly in only a narrow circle, but the pen sends forth "winged words" to the ends of the earth.

A poet, who did not announce his name, gave the world, several years ago, a pleasing description of his embarrassments when solicitous to "write an essay for a lady's portfolio." After describing the first page of his paper "as white and smooth, and empty as air," he says: "I turned to the ink-stand, and looked into it, like Æsop's thirsty crow into the pitcher with a drop of water at the bottom, which the sagacious bird raised to the brim by dropping pebble after pebble into it. But my

difficulty was not to bring the ink out of the stand, but the meaning out of the ink! Ah! quoth I, gently shaking it, here lies the quintessence of all science, all art, all invention, all expression. This drop of ink could speak all languages, discover all secrets, communicate all feelings, display all knowledge, detect all sophistry. There is not a thought which the heart of man can conceive, or a word which human lips can utter, but it is here, absolutely in my hand, before my eyes; yet I am so blind, or so stupid, that I can discern nothing but a decoction of nut-galls and copperas. Oh that I had a chemical test, whereby I might analyze this little fluid, and learn—not what it is made of, but what might be made of it!

"I am too dull at present to fish up a single idea from the bottom: yet if ten thousand people were to sit down to the experiment, each one would produce something different from every other; and were they all to record their thoughts in this ink, with this pen, on this paper, their themes, their thoughts, their diction, would appear as diverse as their faces, their voices, and their handwriting."

The pen may be used for good or evil. Cowper says—

> The sacred implement I now employ
> Might prove a mischief, or at best a toy;

THE PEN.[1]

> **A trifle, if it were but to amuse:**
> **But, if to wrong the judgment, and abuse,**
> **Worse than a poniard in the basest hand;**
> **It stabs at once the morals of the land.**

Instances are not wanting, unhappily, in which it has been used for the worst purposes; it is well there are others in which it has been employed for the best. To communicate valuable knowledge, especially that which is calculated to lead the mind, under a sense of sin, to the only Saviour, is indeed to use it well. For such a service great genius is not required; persons of humble powers may, in this way, be useful. An old writer has said, "The letter from a Christian friend, which has nothing about Christ in it, is not worth the postage, though it stated that he who received it was entitled to a valuable estate." Let it, then, be the concern of every reader, first to obtain, in the exercise of faith, a personal interest in that Saviour who died the just for the unjust, and then, by all the means that can be employed, urge others to seek his mercy. A sentence, a few words, even a single word, has been rendered effectual, by the Holy Spirit, to a sinner's salvation.

CHAPTER II.

THE ART OF DYEING—EARLY USE OF THE KERMES—ITS HISTORY —COCHINEAL INSECTS—HUMILITY ENJOINED.

In offering further information as to gall insects, it is desirable to remark, that one of the earliest of the arts was that of dyeing. The love of ornament is one of the common dispositions of men. So strong, indeed, is this feeling, that savage people, when without clothes, have been accustomed, as is well known, to paint their bodies in a variety of hues. It has sometimes been said, that "the coat of many colours" made by Jacob for his son Joseph, proves that dyeing was known at that early period; but this is by no means the case. It is probable that this tunic, made for the patriarch's much-loved child, was formed of differently coloured pieces, joined together, to produce an agreeable effect. In India it is still a custom to invest a favourite or beautiful child with a "coat of many colours," consisting of crimson, purple, and others, the portions of which are

often tastefully sewed together. Superstition is apparent in this gift; for it is believed, that if a child is clothed in a garment of many colours, he will neither be injured by tongues nor evil spirits, their attention being taken off from the beauty of the person to that of the garment. Soon may the light of the gospel banish such superstitions for ever!

Though it does not follow that the coat of Joseph was dyed, it must be admitted that as most of the materials fit to be manufactured into tissues are dull and sombre in their hues, any hint would naturally be seized with eagerness to obviate this unpleasantness. The effects produced by the juices of plants and fruits, and also by rains on certain earths and minerals, might furnish suggestions that would thus be turned to account. In all climates, it has been said, men have substances of various kinds, adapted to produce diversity in the appearance of their clothes. Still there must have been great difficulty in finding out how they were to be used. Many experiments must have been made, and many disappointments experienced, before any success could have been obtained.

To the colour of purple we have a frequent reference in the sacred, as well as in uninspired writings. The preference given to it as a royal colour may be

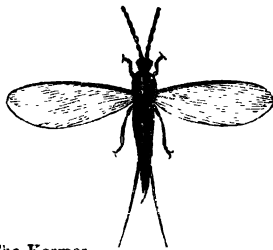
accounted for, in part, by its richness, and also, in part, by its great value in ancient times. It is associated with the monarchs of by-gone days, and with the services offered to their idols by the heathen. In the book of Exodus, too, it is frequently mentioned in connexion with the dress of the high priest, and the works of the tabernacle.

It is important to observe, however, that the word purple, in ancient writings, does not denote one particular colour. Pliny mentions the differences apparent in some of the purples. One was faint, approaching to our scarlet, and considered inferior; another was a deeper red; and a third was deeper still. It is stated, that when the beautiful purple of Tyre was first discovered, it was appropriated by the sovereign, to whom it was presented, as a royal distinction: but this seems to have been of the deepest colour referred to by Pliny The Tyrian purple, in fact, was not one particular colour, but a class of animal dyes, as distinguished from those which are vegetable, and varying from the most faint to the most intense hue.

No doubt exists as to the means by which these colours were obtained. In addition to the dye produced by a mollusk, called the murex, a crimson or scarlet colour was known in ancient times, produced by an insect.

It was called the kermes by the Arabs, kokkos by the Greeks, and thola by the Phœnicians. We owe to the name first mentioned, our words carmine and crimson. The curtains of the Jewish tabernacle are supposed

The Kermes.

(Male.) (Female.)

to have been dyed by means of kermes. The reds of the Flemish tapestries were obtained in the same way. During the middle ages, the epithet vermiculatum was used for the insect producing this colour, and from this is derived our word vermilion.

The female of the kermes reaches the size and form of a pea. Its colour is of a violet black, and it is covered by a whitish powder. This species is common over the

south of Europe on the evergreen oak, and appears to be widely distributed over many of the south-eastern countries of the ancient world. It abounds in Spain, where it attaches itself chiefly to the twigs and leaves of a small species of spiny-leaved oak.

The females of the kermes finish their laying without its being perceived, because all their eggs are covered by their bodies. There are, however, some species in which they cover but a part. The eggs of the latter are lodged in a mass of threads of silk or cotton, which is very white, and causes them to be taken for the eggs of the spider. The mass covering the nest of eggs is usually of a rounded form above. When touched but slightly, the covering attaches itself to the fingers, and a great number of parallel threads are removed. This colouring matter is not spun, but it escapes from under their shell—a beautiful provision for a special purpose.

Pigeons are said to be very fond of the kermes, which renders it necessary to watch them during the period of its gathering. The peasants of certain districts in France, and those of some other countries, collect every year a precious harvest, without the trouble of tilling the land, or sowing the grain. In the south of France the insect is called graine d'écarlate, and vermillon. The harvest is more or less abundant as the winter has

been more or less mild. Should this season pass off without fogs or frosts, there is every expectation of the harvest being good. The oldest trees, and those which appear the least vigorous, and are the least raised, are most laden with kermes. The soil also contributes to their bulk, and the brightness of their colour. The insect, which comes from shrubs near the sea, is larger and of a more brilliant colour than that which comes from shrubs more remote from it.

The harvest of kermes is gathered in by women. They remove with their nails the insects from the shrubs, and one may gather two pounds a day. Sometimes there are two harvests in a year. In the second the insects are attached to the leaves, but it is neither so large nor so useful as the first.

The kermes is wetted with vinegar, that the pulp or red powder it contains may be removed. The insects are then washed in wine, and after being dried in the sun, are polished by rubbing them in a sack, and they are shut up, mixed with a quantity of their own powder. The price of the kermes depends on the greater or smaller quantity of powder which they yield. The best powder is that which comes out of the hole which is on the side where the kermes is fixed to the tree. Prior to the discovery of cochineal, kermes was the material

universally used for dyeing the most brilliant red then known. The latter has now supplanted it in Europe, where it is little attended to, except by the peasantry of the provinces in which it is found, but it is still employed in a great part of India and Persia.

The history of the cochineal insects, which we have now particularly to consider, was for a long time very obscure, and the species employed in commerce was even at one time considered as a kind of grain. Their insect origin was only discovered towards the close of the seventeenth century. They are natives of Mexico, where they were reared assiduously long prior to the European conquest of that country.

Of these insects there are several varieties. They are named from the provinces where they are reared. Of these the one called Mastique, or Mèsteque, is considered the best.

This insect is reared on a tree, which the Indians call nopal. It is the female insect that is so much prized for the beauty of its colour, which some ascribe to the juices of the plant.

The nopal is a plant consisting of little stems, its buds being furnished, when in a flourishing state, with multitudes of little prickles. It expands into wide thick leaves, which in some kinds are more, and in others less,

prickly. One or two of these leaves being set as a plant at the distance of two or three feet square from each other, are inoculated, as it is called, with the cochineal. The process is the same as if a small quantity of the

The Nopal on which Cochineal Insects are represented as feeding. The male on the left, and the female on the right, are magnified.

blight were taken from an apple, or other common tree, and rubbed on one which is free from it; when, as the

result, the tree so inoculated would become covered with blight. A small quantity of the insects is sufficient for each plant, which, as it increases its leaves, is sure to be covered with the cochineal. When the plant is well saturated, the insects are scraped off with great care.

The natives of the districts in which these creatures are reared, raise plantations of the nopal tree near their dwellings. It grows freely from cuttings, which are fit to receive the insects in eighteen months. In a small nest, formed of tufts of a thread-like substance, gathered from a species of palm, or of any other cottony matter, a few females are placed, about the middle of October, at which fine weather usually begins after the rains. Nests of this kind are attached to the spines of the tree, on the side facing the rising sun. The eggs are soon laid and hatched; and, as each female produces upwards of a thousand young, a large colony of these little creatures is soon spread over the tree. It is said that six generations are produced in a year.

These insects, of both sexes, on first leaving the egg, are rather active, and run about among the leaves and branches of the trees. So small, however, are they at that time, that they cannot be seen without a microscope. They are flat, ovular, and without wings, with

short and indistinct antennæ, or horns. The females have a small, short, and almost conical beak, placed between the first and second pair of feet, containing a sucker of three pieces, in a four-jointed sheath. It is by this means they draw forth the juices of the leaves and tender stems. They also fix themselves from time to time, in order to change their skin; and, after arriving at a certain size, they become attached to some chosen spot, where they form a little nest, protected by a tapestry of cotton.

When the insect has reached what is called its perfect state, it is filled with a multitude of very small eggs.

The egg-laying is a very curious process. The eggs do not appear externally, but are made to pass beneath the body, and between it and the cotton tapestry. As, however, the insect becomes empty, the lower surface of the body approaches the upper one, and leaves beneath the body a kind of arch to receive the eggs. The female never moves from her place, but having laid her eggs, she dies, and her body, shrivelling up and hardening, becomes a covering for the young when they are hatched. As soon as this is done, they work their way from the dead body of their parent.

The caterpillars of the males are much fewer than

those of the other sex, though by no means rare. As they have no sucker like the females, their mode of support is not clearly known, but they increase in size, and after a time their skin hardens, and serves as a cocoon. From this they pass into the chrysalis state.

The insects are first collected about the middle of December, and are removed from the tree by a knife with the edge blunted. As soon as this is done, the nests are taken away, and the dead females picked off. These are lighter, and of less value, than those which are removed alive, the former losing more than the latter by drying. Each kind may, however, be kept for any length of time without further loss.

The cochineal arrives in Europe in the form of a small grain, having a convex and a concave side, and having some traces of the segments of the body of an insect.

The tincture of cochineal alone yields a purple colour not very pleasant, which may be made, by a solution of tin in aqua regia, a most beautiful scarlet. This was discovered by a singular accident. A person having placed in his window an extract of cochineal, made with boiling water for the purpose of filling a thermometer, some aqua regia dropped from a phial broken

by accident, which stood above it, and changed the purple dye into a most beautiful dark red. He afterwards found that the tin deposited in the aqua regia caused the change. An ingenious dyer at Leyden brought the discovery to perfection. The secret afterwards became known, and a large dye-house was erected by the celebrated Giles Gobelin, at Paris. About the year 1643, a Fleming, named Kepler, established the first dye-house for scarlet in England at the village of Bow, on which account it was called, at first, Bow dye.

Another remarkable product of insects of the same species is lac. It is collected from various trees in India, where it so abounds that it could be readily supplied to ten times the present amount. It is used in this country for beads, and rings, and other female ornaments. Added to lamp or ivory black, after being dissolved in water having in it a little borax, it forms an ink, which, when dry, is not easily acted upon by damp or water. Mixed with sand it forms grindstones. In its native state, adhering to the twigs, it is called stick-lac; when separated, pounded, and freed from the greater part of the colouring matter, it is called seed-lac; when melted and made into cakes, lump-lac; and when stained and formed into trans-

parent plates, shell-lac. It was for a time chiefly employed in varnishes, japanned-ware, and sealing-wax, but more recently for dyeing scarlet.

In closing these statements as to a class of insects but little known, yet well entitled, as must now be apparent, to our attention, we are reminded of our obligation to God for the inferior creatures which his hand has made. Benefits come to us, directly and indirectly, even from the insect tribes; for many are the substances offensive to us, which speedily swarm with these little creatures, who consume what is noisome, and leave only what increases the fertility of the soil. Stagnant waters, which would otherwise exhale putrid vapours, and cause fatal disorders, are purified by innumerable numbers of insects which live in them, and extract whatever is unwholesome in their contents. The vast regions where thousands of giant trees fall victims to the slow ravages of time, or the more sudden force of lightnings and hurricanes, exhibit neither ruin nor desolation, but the verdant characters of youth and beauty, because insects assist the influences of nature in their decomposition, and provide the nutriment for a useful growth.

Injuries are sometimes suffered from insects, but their devastations are not the same in every season,

their power of doing mischief being evident only at certain times. And when do these occur? Just when Providence, permitting an unusual increase of their numbers, gives them charge to lay waste any particular district. It is important, however, to keep the noxious species within proper limits, and this is done by other insects.

Numerous are the tribes on which this important task devolves, and incalculable are the benefits they are the means of bestowing upon us. Created by God for this special purpose, they are the instruments of preventing our cattle, our crops and grain, our pulse and flowers, our fruit and forest trees, and even the verdant covering of the earth, from being wholly destroyed. Of these insects, so friendly to man, some destroy solely as caterpillars, and others only as perfect insects, while others do so in both these states, and also in that of chrysalises.

It should not be forgotten, that many quadrupeds, which, though not all of direct utility to us, are doubtless important in the scale of being, derive a considerable part of their subsistence from insects. Nor is it less certain that they form wholly, or in part, the food of some of the most esteemed birds and fishes that are brought to the table; while the songsters that

enliven our groves are dependent on them in common with other creatures.

Much might be said of the direct benefits which accrue to man from the insect tribes, in addition to those already mentioned. Locusts are often used for food in the east; and if any are surprised at this, let it be remembered that the Arabs are as much astonished at our eating crabs, lobsters, and oysters. How much are we indebted to the little creatures that yield us wax, honey, and silk! but on these we cannot now expatiate. No present has ever been made by these tribes to the arts, equal in utility and general interest to the product of the insects on which we have now been dwelling. Let, then, these makers of galls have their proper place in the mind of the reader.

How vain and sinful is the pride which, though thus dependent, we sometimes display! Let us guard against this evil; let us cherish the humility that becomes us; and let us remember that every advantage, however derived, is a proof of the goodness of God to the undeserving, which commands continual gratitude and praise.